THE GEOGRAPHY OF OIL IN THE PERSIAN GULF

by

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ABSTRACT

This thesis studies the different aspects of the petroleum industry in the Persian Gulf. As the Gulf* covers a vast area, three major oil producers, Kuwait, Saudi Arabia, and Iran have been selected for discussion. Production from these countries contributes the major proportion of the Gulf's output of oil.

The first chapter is a brief geographical introduction to the Gulf, and also shows its location in relation to the main oil producing and consuming countries in the world. The effects of political boundaries on the oil companies are analysed.

The second chapter is concerned with historical geography of oil exploitation and development in the Gulf, particularly with concession agreements, since these bore closely on the pattern of external control of the oil resource.

The location of known oil reserves are outlined in the third chapter, as well as the way in which labour costs and physical factors can affect the cost of production. Production in each of the three countries is then studied.

Chapter four deals with the internal movement and storage of oil, and the way it is differently affected by the physical features of the countries under discussion.

Means of transporting oil from the Gulf to the main oil markets are analysed in the fifth chapter. The comparative advantages and disadvantages of both pipelines and tankers are shown, and the Suez Canal is discussed in order to demonstrate its effect on oil transport. The main importing terminals

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* I have referred throughout to the "Gulf" in order to avoid confusion, as on the Iranian side it is known as the Persian Gulf, and on the Arab side, as the Arabian Gulf.

in Western Europe are also examined.

Petroleum exports are analysed in chapter six. Areas of demand are discussed, along with the regionally varied influence of political crises on oil exports. The two Suez Crises of 1956 and 1967 are particularly selected, as they led to the consuming countries attempting to diversify the sources of their oil supplies from the Gulf to other parts of the world, and modified the geographical pattern of crude oil supply.

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INTRODUCTION

This thesis will analyse various aspects of the geography of oil in the three main producing countries around the Gulf. After a short general introduction to the area, Chapter One first examines the location of the Gulf as an oil producing zone in relation to the major oil producing and consuming countries of the world, and secondly illustrates . the varying influences bearing on the exploiters of the resource by the political boundaries of the countries involved.

Chapter Two is concerned with the historical development of oil exploitation around the Gulf. It considers earliest oil exploitation with special attention to the Gulf, the demands of industrial advancement in Europe, and developments in the early 20th century, as well as the modern phase of rapid development, and regional differences in exploitation development occasioned by political influences in the countries around the Gulf.

Chapter Three outlines the locations of the known reserves of oil in the area. It examines closely the varying costs of production due to physical factors and labour costs. The actual production regimes of the three countries are then analysed in detail.

Chapter Four investigates the pattern of intermediate oil movements related to such critical features as land surface, and sea-bed topography. These are discussed as they vary from country to country and influence inland transport of the resource and oil terminals.

Chapter Five analyses means of transport from the Gulf to the consuming areas. This includes tankers, receiving points (the main oil importing ports of Western Europe), the Suez Canal, and pipelines. A comparison between tankers and pipelines will be made in order to show the advantages and disadvantages of each mode of transport. The Suez Canal is included to show its effect on oil transport.

Finally, Chapter Six is concerned with the export of oil. Here it is intended to show the areas of demand and the influence of political crises on oil export, notably the Suez crises of 1956 and 1967.

CHAPTER I

INTRODUCTION TO THE GEOGRAPHY OF THE GULF

1. A Brief Account of the Gulf

The Gulf is one of the arms of the Indian Ocean penetrating the very centre of the old world, the other being the Red Sea. The two arms run almost parallel to each other to a latitude of 30°N, giving access to Europe from the Indian Ocean. Topographically, the Gulf, together with Mesopotamia, forms a great depression, and separates the Iranian Plateau from the Arabian. The depression is bordered by one of the richest oil producing regions of the world.

Several different countries border the Gulf. It is bounded in the east by Iran, and in the north and west by a number of Arab countries and Shaikhdoms. (See Fig.1). From the most northern point, where the Shatt al-Arab river enters the Gulf, the seaboard running to the west as far as Khor Abdullah belongs to Iraq. Thereafter, Kuwait extends for about 90 miles, and the Neutral Zone, which is divided equally between Kuwait and Saudi Arabia, occupies about 45 miles. From the Neutral Zone onwards to the Gulf of Salwa, 250 miles of the coast line belongs to Saudi Arabia. The Shaikhdom of Qatar, which occupies the Qatar Peninsula, has a coastline of about 90 miles, and the Shaikhdom of Bahrain consists of an archipelago between the extreme north point of the Qatar Peninsula and the mainland. From the eastern base of the Peninsula, the coast inclines eastwards and then bends north, forming a great arc. This coastline, which is known as the Pirate, or Trucial Coast, terminates in the mountains of the Masandam Peninsula which overlook the Strait of Hormuz, the narrow passage linking the Gulf with the Gulf of Oman.[1]

The Gulf, which covers an area of about 97,000 square miles,[2] lies

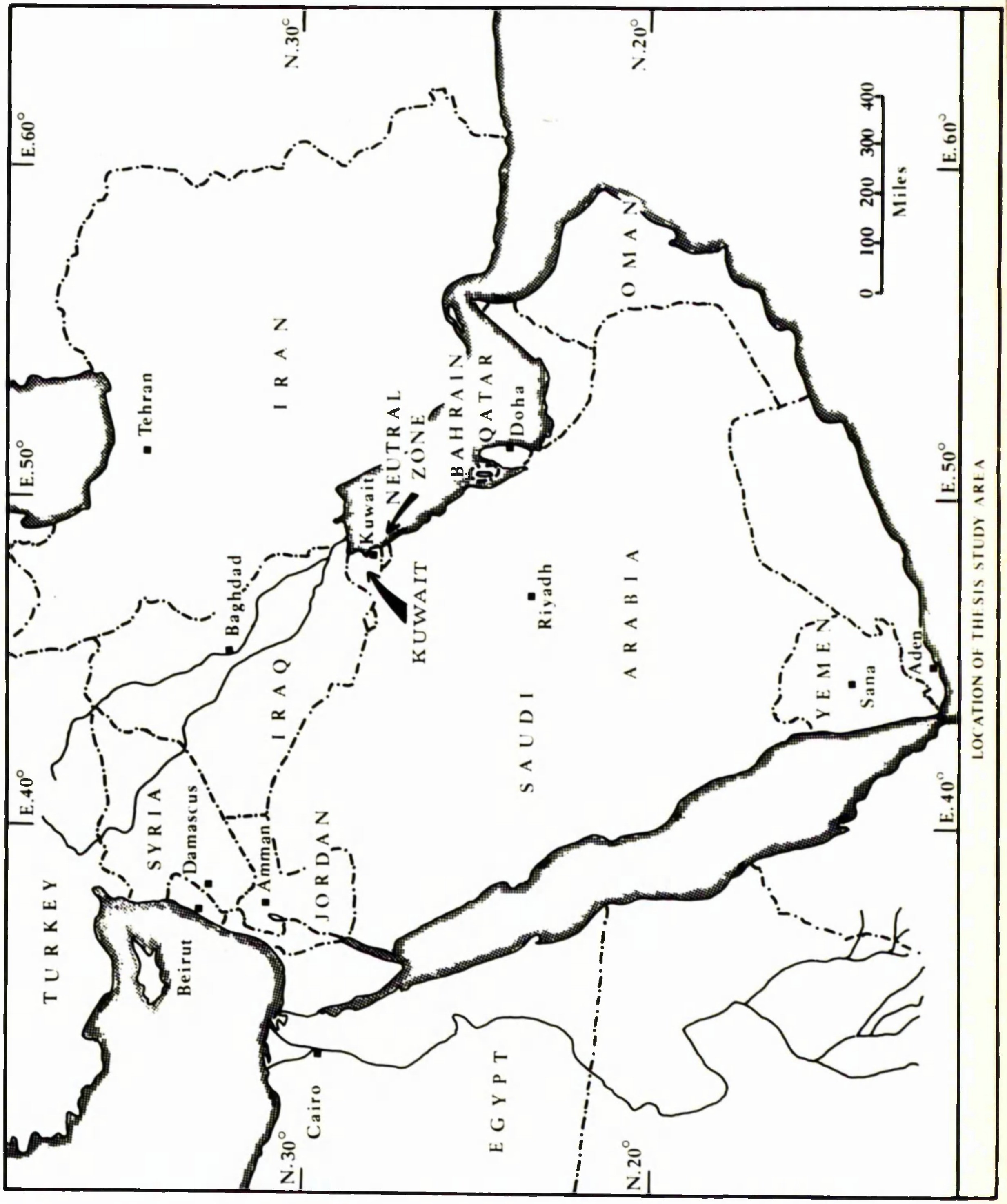

Fig. 1 - Location of Iran, Saudi Arabia and Kuwait in the Middle East.

roughly north-west and south-west between latitudes 24° and 30° North and longitudes 48° and 57° East. The Gulf's length from the mouth of the Shatt al-Arab river to the Strait of Hormuz is some 500 miles (from the Strait to the Indian Ocean is about 300 miles). The breadth of the Gulf varies from 140 miles at the head and 50 miles at the entrance, to 200 miles at its widest part.[3]

The Gulf, which has a coastal length of approximately 2,000 miles, is surrounded for about two-thirds of that distance by mountain ranges. On the Iranian side the mountain ranges run parallel to the sea, and in some places they run steeply down to it. These mountains increase in height as they recede inland. Wide valleys separate them, and there are belts of lowland of varying width between the mountains and the sea.

With the exception of the Masandam Peninsula, which is a barren mountain, the Arabian coast, or southern and south-western shore of the Gulf, is composed of low-lying sandy beaches. From the coastal line for almost its whole length, reefs and shoals extend for 30 to 50 miles in places. There are numerous islands off-shore, and many inlets, some of which extend many miles inland.[4]

The water in the Gulf is extremely shallow, and only in a few places does the depth exceed 50 fathoms. Close to the Iranian shore lies the deepest channel of the Gulf. Beyond the Strait of Hormuz, in the Gulf of Oman, the depth increases rapidly reaching a maximum of 1,800 fathoms.[5]

The lack of water depth in the Gulf creates some difficulties for oil companies involved in the area. In order to transport the produced oil, the oil companies had to either construct long piers, or lay submarine loading lines for loading oil. In both cases construction costs are high. However, in recent years, this lack of depth has proved advantageous with regard to offshore drilling, as can be seen from the difference between the costs of drilling in the Gulf and the North Sea.

2. Location in Relation to Major Oil Producing and Oil Consuming Countries

It may be noticed from Figure 2 that the oil producing areas of the world are widely distributed. At present six regions appear as the major producers of the world. In North America, the U.S.A. with its output of 525.4 million tons of crude oil in 1970, leads the world. Venezuela, with an output of 189.9 million tons, takes second place in the Western Hemisphere. The Gulf, which is a part of the Middle East, counts as a secondary region among the oil producers. However, as far as individual countries are concerned, the U.S.S.R., with its production of 347.3 million tons, comes after the U.S.A. Output from countries surrounding the Gulf (Iran, Saudi Arabia, Kuwait and Iraq) accounted for 566.7 million tons in 1970. This represented 81.3% of the total Middle East production. Africa, with its production of 267.7 million tons, takes fourth place, and South East Asia comes fifth.[6] It may be noticed from Figure 2 that some producing regions are favoured in their location as oil exporters. For example, Venezuela is situated close to the U.S.A., which is the world's largest consumer, and North Africa is located not far from Western Europe. Thus export opportunities are greater for these than for the Gulf countries where the oil has to be transported further.

The Gulf is rich in oil, but its consumption is relatively low. This low consumption is due to a lack of industries which use oil as their source of energy and a generally low local energy consumption per capita*. For example, in 1968, the local demand for oil in Iran amounted to only 255 thousand

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* Local consumption has increased recently because of the introduction of petrochemical industries into the countries concerned.

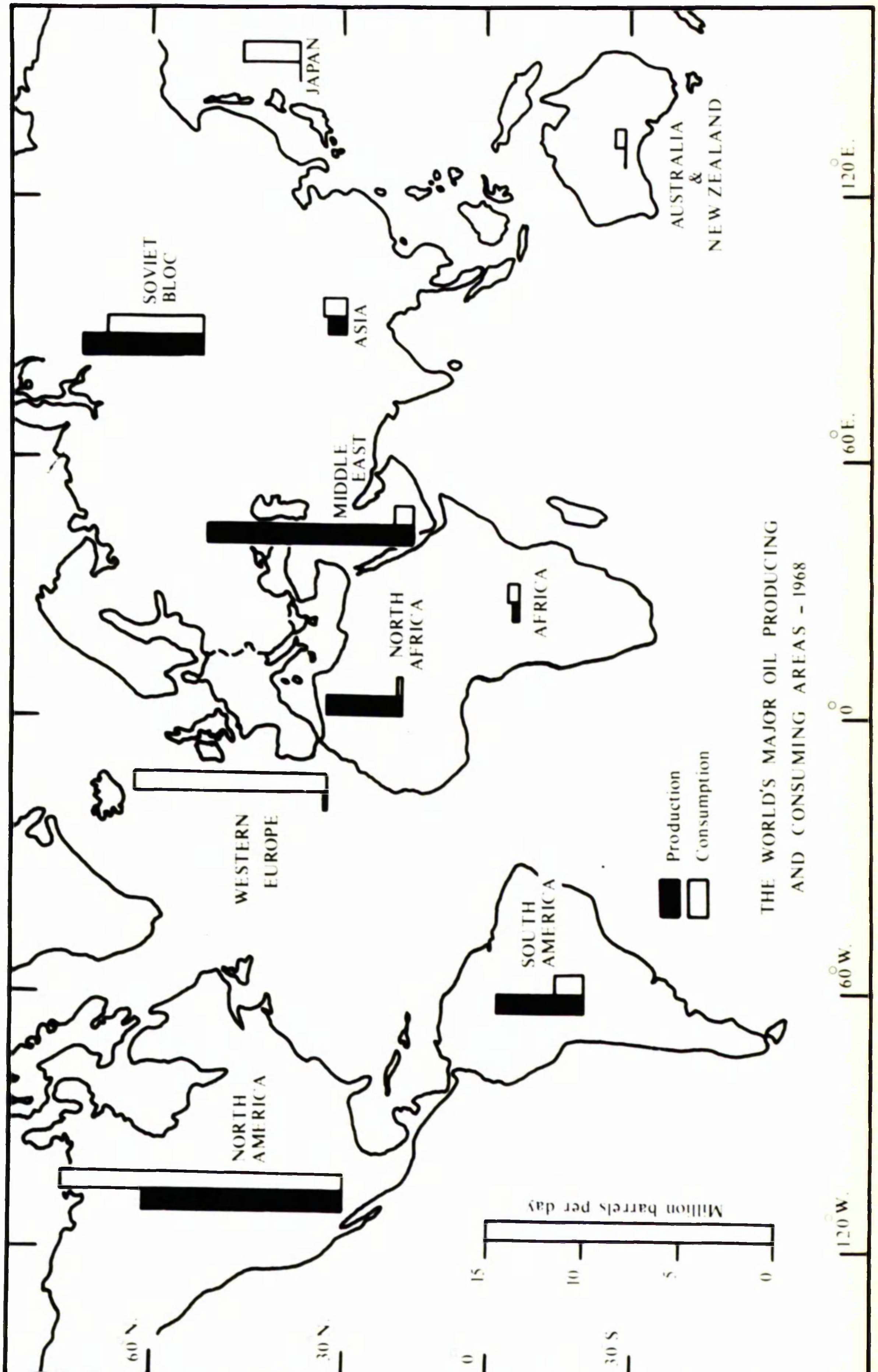
THE WORLD'S MAJOR OIL PRODUCING AND CONSUMING AREAS - 1968
Production
Consumption
Million barrels per day
15
10
5
0
NORTH AMERICA
SOUTH AMERICA
WESTERN EUROPE
NORTH AFRICA
AFRICA
MIDDLE EAST
SOVIET BLOC
ASIA
JAPAN
AUSTRALIA & NEW ZEALAND
60°N
30°N
0
30°S
120°W
60°W
0°
60°E
120°E

Fig. 2

barrels per day. Other countries such as Saudi Arabia, Kuwait and Iraq, showed an even smaller demand. Their consumption amounted to 130; 115 and 70 thousand barrels per day respectively, but the production of these countries was much higher than this. It was 2,830 thousand barrels per day in Saudi Arabia, 2,421 in Kuwait and 1,506 in Iraq.[7]

Apart from the low local consumption, it is also difficult to export the produced oil to the neighbouring countries, because these are underdeveloped and their consumption counts for little, compared to the vast production. Thus the oil has to be moved far from the region, to the consuming markets. Western Europe represents the main importer of Gulf oil, while Japan and the Far East take second place. After these come North America, Australia and New Zealand, followed by the rest of the world. Moving the oil to the markets involves using large tankers, which greatly affects oil prices in the consuming areas. Here it is possible to say that the distances between the producing and the consuming countries are very important, as export competition exists among the producers. Competition from the new major producing areas of North Africa is already rising in importance, particularly where they are located near to the importing countries (Western Europe). For example, the distance from London or Liverpool to Kuwait, via the Suez Canal, is 6,500 sea miles, and 11,300 miles via the Cape of Good Hope route. From Ras Tanura on the Gulf, to New York via the Cape of Good Hope is 11,900 miles, while via the Canal it is only 8,400.[8]

3. A Short Discussion on the Borders of Kuwait, Saudi Arabia and Iran

This section will deal with the boundaries of Kuwait, Saudi Arabia and Iran, as these are the countries with which this thesis is concerned. In the case of the latter two, only areas of dispute will be dealt with, while it is intended to analyse all of the boundaries of Kuwait because of her location in the centre of the countries under discussion, and because her boundaries have given rise to several problems where the oil industry is concerned. To clarify information about the area of dispute, the boundaries will be analysed under two headings:

a. Land boundaries

b. Distribution of the offshore areas of the Gulf (Continental Shelf).

a. Land Boundaries

Kuwait

To the bedouin mind the notion of a fixed boundary is completely foreign, as the tribesmen have roamed the peninsula since time beyond memory, in search of water and grazing. Usually only coastal towns, oases or water wells were claimed as belonging to anyone in particular, while the desert between these was looked upon as a sea, open to all who chose to travel on it.

However, the need for the exact delimitation of the desert was generated by two events. One of these was the growth of British influence in the states on the coast of the Gulf, in Oman, Aden and the Hadhramout. The other was the discovery of oil.[9]

Negotiations between Britain and the Ottoman Empire regarding some outstanding questions on Eastern Arabia started in the summer of 1911. These dealt with the Baghdad Railway and its possible extension to the head of the Gulf.

On 29th July, 1913, the first major attempt to settle the boundary question was made, when a convention was conducted by Britain and the Ottoman Empire, concerning the Gulf area.[10] As a result, the boundaries were defined between Kuwait and the Ottoman Sanjak* of Najd in Article 5, and Qatar and Sanjak of Najd in Article 11 of this convention.[11]

During the negotiation of the convention, events which could complicate its final application were taking place in eastern Arabia. For instance, in May 1913, working from Najd, Ibn Saud overran Hasa, driving out the Turkish administration. He then announced his intention of ruling the province himself. In the years 1925, 1926 and 1927, Ibn Saud won Mecca, Medina and Jiddah respectively, from the Sharifiyan King Hussein. Shortly afterwards, he proclaimed himself King of Hijaz. (Following the annexation of Jabal Shammar in 1932, he changed his kingdom's name to Saudi Arabia.)[12]

However, in 1913 definitions were never ratified, and it was necessary to reach new agreements on the boundaries of the successor states after the First World War, and the fall of the Turkish Empire. An agreement was made in 1922, with both King Ibn Saud (then Sultan of Najd) and Britain, called the Treaty of Oqair, which defined the southern boundary of Kuwait. The northern and western ones were agreed with Iraq in 1932, when she gained her independence. Although Kuwait is lucky in knowing roughly where her boundaries are, the definitions are open to question. The following is the definition of the western and northern boundaries with Iraq:-

The frontier runs from the intersection of the Wadi al-Auja with the Batin (see Fig.3) to a point just south of the latitude of Safwan, then eastwards to Jabal Sanam and Umm Qasr, leaving them with Iraq, and so, on to the

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* Sanjak (Turkish), sub-province, second largest administrative unit in the Ottoman Empire.

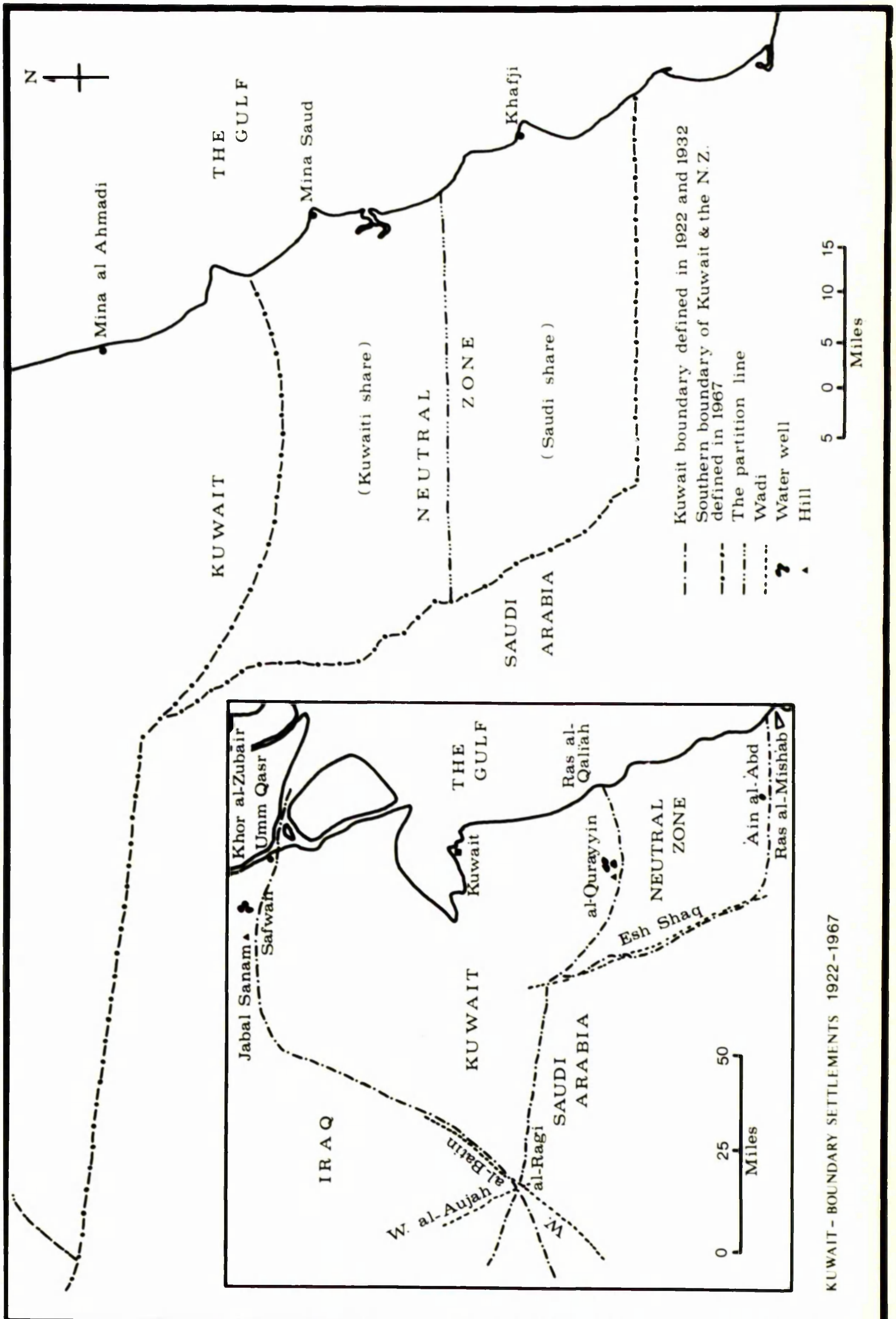

Fig. 3 - Boundaries of Kuwait and the Neutral Zone in 1922 and 1967.

junction of the Khor (Khor means creek) Zubair and the Khor Abdullah.* This definition, which corresponds with that of the Anglo-Turkish convention, is patently vague. At one time a post was erected on the road between Kuwait and Safwan to mark the frontier, but it was removed several times, and finally was not replaced. Also, the Khor Abdullah is more or less a continuation of the Khor Zubair, and it is by no means certain where one starts and the other finishes. It has not yet been decided when demarcation will be commenced, but it will be an extremely arduous task for the people appointed to it.[13]

After the visit of the Ruler of Kuwait to Iraq on the 7th June, 1966, a communiqué was issued, which provided for a committee to be formed for the demarcation of borders between the two countries. However, this committee accomplished nothing, as it never came into existence.[14]

This lack of demarcation has a great effect on oil exploitation for both countries in the vicinity of this line. The oil companies always try to avoid surveying there to lessen the possibility of trouble between the two countries even if they are certain of the existence of oil. For example, Jirfan area, to the north of Kuwait and adjacent to the area of dispute, has not been fully exploited by Kuwait Oil Company, although work was started there before 1965.[15] Also, according to a newspaper report on the 26th April, 1964, "a Kuwait Oil Company drilling team working in the undemarcated areas along the Iraqi border

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* H.R.P. Dickson, in his book Kuwait and her Neighbours, further elaborates:-

"As far as I can remember, Ibn Saud took little further part in the frontier discussion, leaving it to Sir Percy to decide for him this vexed question. At a general meeting of the conference, Sir Percy took a red pencil and very carefully drew in on the map of Arabia a boundary line from the Persian Gulf to Jabal Anaizan, close to the Transjordan frontier. This gave Iraq a large area of the territory claimed by Najd. Obviously to please Ibn Saud, he ruthlessly deprived Kuwait of nearly two-thirds of her territory and gave it to Najd, his argument being that the power of Ibn Sabah (the desert title of the Shaikh of Kuwait) was much less in the desert than it had been when the Anglo-Turkish agreement had been drawn up." (Dickson, Kuwait and her Neighbours, London 1956, p. 274.)

was recently intercepted by an Iraqi patrol and ordered to stop drilling operations on the ground that the well site was in Iraqi territory".[16]

At the Oqair conference of the 2nd December 1922, a boundary dividing the Sultanate of Najd from Kuwait and Iraq was agreed upon by both Saudi and British representatives. The unratified 1913 convention was also referred to. The following was said at the Oqair conference in respect of the southern boundary of Kuwait:-

> The frontier between Najd and Kuwait begins in the west from the junction of the Wadi al Auja (Wadi al Audja) with the Batin (El Batin), leaving Raqi (Rikai) to Najd; from this point it continues in a straight line until it joins latitude 29° and the red semi-circle referred to in Article 5 of the Anglo-Turkish agreement of 29th July 1913. The line then follows the side of the red semi-circle until it reaches a point terminating on the coast south of Ras al-Qaliah (Rasil Kaliyah) and this is the indisputable southern frontier of Kuwait territory.[17] (See Fig.3).

Article 5 of the 1913 draft convention describes the line as follows:-

> The autonomy of the Shaykh of Kuwayt is exercised by him in the territories, the limit of which forms a semi-circle with the town of Kuwayt in the centre, the Khol al-Zubayr at the northern extremity and al-Qurayyin at the southern extremity.[18]

This definition is so loose that it is very difficult to apply. An area of several square miles is covered by the town of Kuwait, and the centre of this is not settled. Qurayyin cannot be used as a landmark, because a hill and a group of wells several miles apart both bear this name. As a result, there are ambiguities enough to make firm claims to immediately neighbouring ground impossible, in spite of the apparently complete description of the boundary.[19]

<u>The Kuwait-Saudi Neutral Zone</u>

The boundary of the Kuwait-Saudi Neutral Zone, which is situated south of Kuwait, was also decided at the Oqair conference of 1922. This definition, like that of Kuwait's borders, lacks precision in the way in which the convention describes the limits of the Neutral Zone.

The portion of territory bounded on the west by a low mountainous ridge called Esh Shaq and on the east by the sea, and on the south by a line passing from west to east from Esh Shaq to Ain al-Abd and "thence to the coast north of Ras al Mishab (Ras al Mishaab), in this territory the Governments of Najd and Kuwait will share equal rights until through good offices of the Government of Great Britain a further agreement is made between Najd and Kuwait concerning it."[20]

The inability of the two parties (Britain and Saudi Arabia) to agree, led to the establishment of the Neutral Zone. Between Saudi Arabia and Iraq a similar Zone exists. It did not seem necessary to bring the two parties to further agreement, as the Zone concerned was devoid of both water and permanent habitation, and gave rise to no trouble.[21]

However, the Zone became of great importance as a result of oil discovery in the area. In 1948, two oil companies were granted oil concessions in the Zone.* The first of these was from Kuwait to the American Independent Oil Co. (Aminoil) covering its undivided half of the Zone. It was shortly followed by Saudi Arabia signing an agreement with Pacific Western Corporation (now Getty Oil Co.). These two agreements covered the land of the Neutral Zone.[22] In 1957 and 1958, similar concessions were granted to the Japanese Arabian Oil Co. by both governments with respect to the offshore areas of the Zone.[23]

From this it can be seen that the idea of joint sovereignty over the Neutral Zone as proposed in the 1922 Agreement, prevented neither Kuwait nor Saudi Arabia from granting separate concessions to different companies, regarding the undivided share of each country in the Neutral Zone. Thus, it seems that Kuwait and Saudi Arabia deemed it unnecessary to come to a joint concession

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* Major Frank Holmes, in May 1924, secured the first oil rights over the Neutral Zone. Holmes, who was representing the Eastern and General Syndicate of London, lost his rights over the Zone in 1927 due to lack of capital.

agreement with regard to their equal rights in the Zone. Hitherto, the Neutral Zone was run as a condominium, with Saudi Arabia and Kuwait sharing equal responsibilities for the administration of the entire territory of the Zone.

The Oqair convention of 1922 did not establish any constitutional system or joint administration, and neither of these exist as yet. This is probably because the Zone was unimportant before oil exploitation, as previously explained. As further development took place, especially the granting of the offshore concessions of 1957-8, people surged into the Zone to work for oil companies. It was estimated in 1962 that the number of workers in the Zone was 4,000. 55% of this total were from Saudi Arabia, 25% from other Arab countries, 20% non-Arabs, and none of Kuwaiti nationality.[24] As the Zone's inhabitants increased, the problems relating to administration required more attention. Therefore it became necessary for Kuwait and Saudi Arabia to implement a joint meeting in order to find a workable solution to the problem of administration in the Zone. Thus a series of negotiations lasting intermittently from March 1964 to July 1965 were held between the two parties. In July 1965, they finally reached an agreement to partition the Zone into two equal parts with each party annexing to its own territory one part of the partitioned Zone.[25] The partition agreement of 7th July, 1965, put an end to the temporary state which existed under the convention of December, 1922.

> The boundary line between the two sections of the Zone is to be the line which divides them into two equal parts and which begins from a point at the mid-eastern shore on the low-tide line, and ends at the western boundary line of the Zone* .... (Art.I). (See Fig.3.)

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* The partition line was ratified by both Saudi Arabia and Kuwait on the 19th of January, 1970, and the 21st of the same month, respectively. (M.E.E.S. No.14, 30th January, 1970.)

Article III provides that "each of the Contracting Parties shall exercise the rights of administration, legislation and defence over the part of the partitioned Zone annexed to his territory."

The agreement also clarified other vital problems concerning the Zone. Article VII dealt with the exploitation of the natural resources in the territorial sea of the partitioned Zone, for which purpose it was fixed at six nautical miles. Here, each party has the same rights as those applied to the partitioned Zone.

With regard to employment and the labour force, the agreement guarantees freedom of work to both Kuwaitis and Saudis in the partitioned Zone.[26]

On reading the provisions of the agreement it becomes obvious that the parties were concerned mainly with solving the problems arising from the lack of joint administrative machinery in the Zone. What was required was a satisfactory and workable solution that could represent usefully and fairly the rights of both parties in the area. Thus, after the failure of the parties to agree on a joint administrative system in the Zone to represent their joint authority, it was decided that the Zone should be divided into two equal parts, and that each side should annex the part nearest to its own boundary.*

Therefore the northern section of the Zone became part of Kuwait, and the southern section became part of Saudi Arabia (Art. II). The equal rights of both parties in respect of the exploitation of natural resources of the entire Zone, are not affected by the exercise of the exclusive rights of administration, legislation, and defence retained by each state (Art. III). A Joint Permanent Committee, comprising an equal number of members and a Minister of Petroleum from each side, will be set up to regulate measures for the exploitation of the Zone's natural resources, as well as those of the territorial waters and the adjacent

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* The agreement did not deal with the offshore areas of the Neutral Zone.

offshore area. It has been agreed that the status of existing oil concessions in the Zone, both on land and offshore, should continue as at present. However, should the granting of any new concessions be necessary in the future, they would be referred to the Joint Permanent Committee, who are authorised to deal with such matters.

In conclusion, it may be said that the partition agreement solved the problems of administration and jurisdiction of the Zone which had for many years obstructed both parties in the exercising of their sovereign rights on an equal basis. The most significant effect of the 1965 agreement is that it paves the way for the possibility of complete co-operation between the two countries, with regard to future exploitation of the Zone's natural resources.

The demarcation of the Neutral Zone and the common boundary between Kuwait and Saudi Arabia

The partition agreement of 1965 paved the way for another vital agreement, that is the demarcation of the Kuwait-Saudi Neutral Zone and the Common border between Kuwait and Saudi Arabia.

An Amiri Decree was issued by the Ruler of Kuwait on the 24th of December 1967, ratifying the documents relating to the final demarcation of the land boundary of the Saudi Arabia-Kuwait Neutral Zone and the common boundary between Saudi Arabia and Kuwait. In accordance with an exchange of letters between the Saudi and Kuwaiti governments in 1963, a joint Saudi-Kuwaiti technical committee was set up and entrusted with the demarcation of these boundaries. The committee supervised the work of the Japanese firm which did the main work of surveying and demarcation, Pacific Aero-Survey Company Ltd. From the results of this work a "Final Boundary Map" (see Fig.3) was drawn up in 1966 by the committee.[27]

However, neither the status of the islands of Qaru and Umm al-Maradim, nor the demarcation of the northern offshore boundary between Kuwait itself and the Neutral Zone are dealt with in the agreement. The problem of off-shore demarcation is of some consequence, as the overlap between the Shell-held offshore concessions in Kuwait itself and those held by the Arabian Oil Company in the Neutral Zone includes some land which is very possibly oil-bearing. Kuwait claims for herself exclusively the islands of Qaru and Umm al-Maradim, which are located off the Neutral Zone, and these two, along with Kubar Island, which is off Kuwait proper, are the subject of a separate concession grant to Aminiol. However, Saudi Arabia claims that both Qaru and Umm al-Maradim should be included in the Neutral Zone.[28]

Due to the demarcation some adjustment was made to the southern boundary of Kuwait with the Neutral Zone - it moved slightly northward. As a result, Umm Gudair oil field was divided into two parts; the northern section, as before the demarcation, was within the boundary of Kuwait, whereas the southern section was now in the Neutral Zone. It should also be mentioned that the oil companies operating in the Neutral Zone (Getty and Aminoil) did not have a single well in that section before the demarcation. Now, however, they have a number of producing oil wells.[29]

The south-eastern boundary of Saudi Arabia

Saudi Arabia was able to define its north-eastern frontiers in the areas adjacent to Iraq and Kuwait. However, its boundaries with Qatar, the Trucial Coast, Muscat-Oman, and Aden remained undefined. The only valid document which the frontier discussion can be based upon is the Anglo-Turkish conventions of 1913 and 1914.

In Article XI of the 1913 convention, the boundary between Sanjak of Najd and Qatar was defined. This line was to divide the limits of Ottoman jurisdiction in eastern Arabia from that of British influence. It was known later as the "Blue Line", and began to the west of Qatar on the Gulf coast opposite Zakhnuniya Island and took a southerly direction to Rub al Khali desert. However, the Blue Line was never ratified, because of certain events taking place at the time, i.e. Ibn Saud driving the Turkish administration from Hasa, and announcing that the province would be ruled under his jurisdiction.[30] Nevertheless, the 1913 convention did not prove unimportant, as two of its provisions concerning Kuwait and Najd, were used as a basis for later negotiations.

Following the annexation of Jabal Shammar in 1933, Ibn Saud, on 14th July, granted an oil concession to Standard Oil Company of California, covering the eastern region of his kingdom within its frontiers. As these frontiers were not specified, making it impossible to define the exact limits of the concession, the United States government made inquiries, asking the Turkish and British governments for information. On 24th April, 1934, the British government informed the Embassy of the United States in London that the Blue Line of the 1913 convention represented the eastern boundary of Saudi Arabia, and that Ibn Saud succeeded the Turkish sovereignty to the west and north-west of that line.[31] Soon afterwards, the British informed the Saudi government of their view regarding the line. The Saudis denied the validity of the line on the ground that considerable changes had taken place in the position of Saudi Arabia, i.e. the annexation of Hasa, Hijaz, Asir and Jabal Shammer. This was expressed in a note dated 13th May, 1934, to the British Ambassador in Jeddah, Sir Andrew Ryan, which declared readiness to enter into negotiations to define the frontiers.[32] At the beginning of 1935, the Saudi government was asked by Britain to define the frontiers. On 3rd April, 1935, a memorandum was handed to the British Ambassador in Jeddah, proposing these frontiers with Qatar, the Trucial Coast, the Sultanate of Muscat-Oman and the eastern part of Aden.[33]

Qatar's boundary, which started at a point 15 miles from the head of Dauhat Salwa on the west coast of the Peninsula, ran eastwards for about 5 miles, then south eastwards to end on the coast about 7 miles north of Khor al-Udaid. (See Fig.4.) The proposed boundary would cut off approximately one-sixth of the total area of the Peninsula in favour of Saudi Arabia.

At a point about 16 miles south of Khor al-Udaid, the Trucial Coast boundary with Saudi Arabia started. The line took a southerly direction for about 10 miles, then went east-south-east in a curve until it met longitude 56°E at its junction with latitude 22°N. From there it ran down longitude 56°E to its junction with latitude 19°N. Then it turned south-westwards until it reached longitude 52°E at its junction with latitude 17°N, which it followed as far as the "Violet Line".* This was known later as the "Red Line".

Two reasons can be given for the refusal of the British to accept the Red Line. (a) It claimed for Saudi Arabia a coast line of about 23 miles, and separated Qatar from Abu Dhabi, the nearest Trucial Coast Shaikhdom; (b) It took a substantial part of the hinterland for Saudi benefit.

The non-acceptance of the "Red-Line" by Britain provoked new negotiations between the two governments concerned. On 25th November, 1935,

* The Anglo-Turkish convention of 9th March, 1914, agreed on a boundary dividing the Aden Protectorate from the Ottoman territory in Arabia. In Article 3 of the convention, the boundary line (thereafter known as the "Violet Line") was defined. The line ran at a 45° angle from Lekemat al-Shoub, northeast towards Rub al-Khali, where it met the "Blue Line" of the 1913 convention at 20°N.

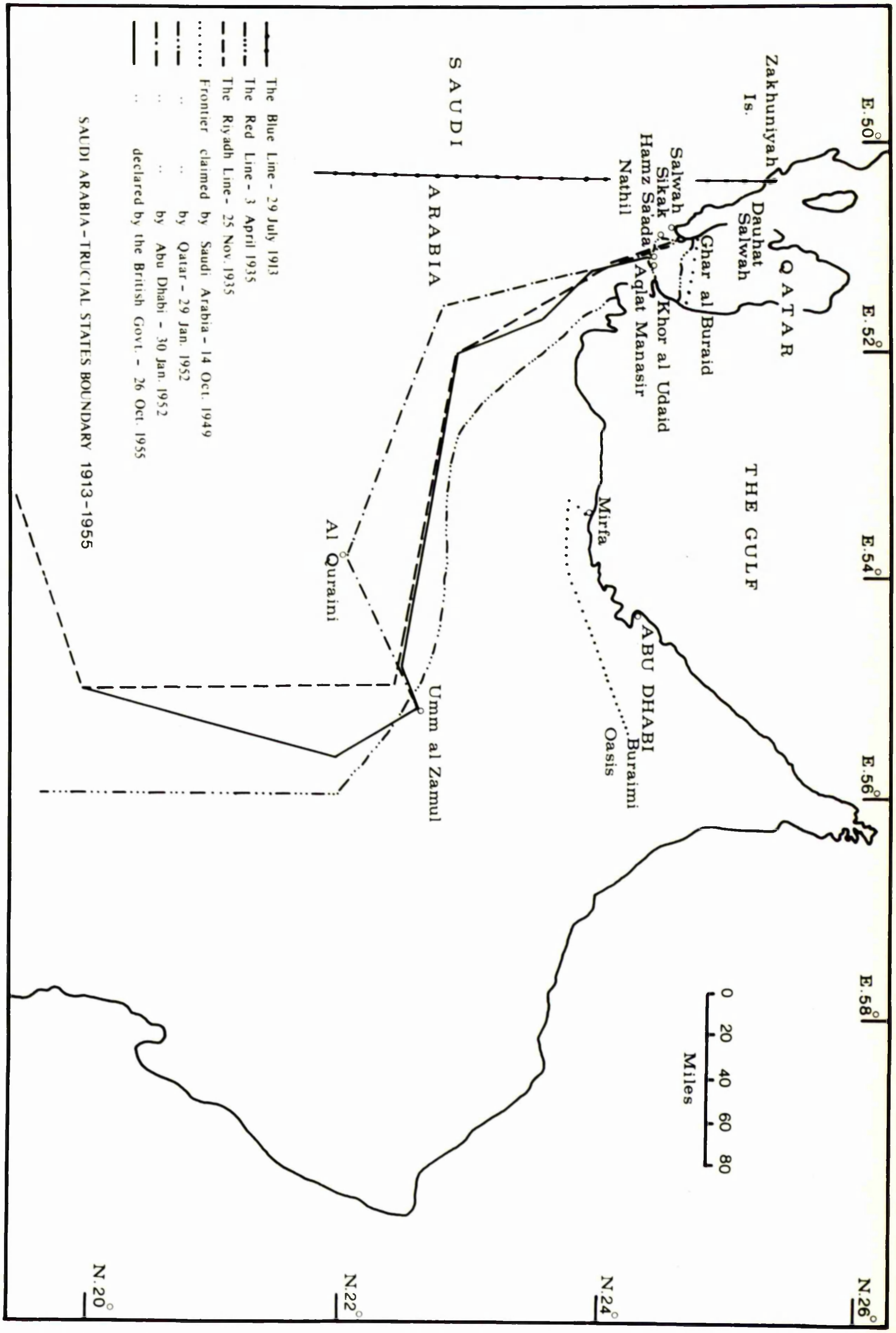

Fig. 4 - The eastern boundaries of Saudi Arabia.

Sir Andrew Ryan handed a memorandum to Fuad Bey Hamza, the Saudi Foreign Minister at Riyadh, which proposed a new frontier between Saudi Arabia and the Trucial Coast, and Qatar.[34] Starting at the head of Dauhat Salwa the proposed line took a south-eastward course, till it struck the southern tip of Sabakhat Matti. Then it went eastward, running along the northern edge of Rub al-Khali, till it joined with latitude 22°30'N and longitude 55°E. From this point the line ran south along longitude 55°E until its junction with latitude 20°N. It then turned approximately south-westwards, and continued in a straight line till its junction with longitude 52°E and latitude 19°N, and then again in a straight line to meet the "Violet Line" at its intersection with latitude 18°N. The line thereafter was known as the "Riyadh Line".* This line was presented to Saudi Arabia by Britain as the furthest possible concession they could make. Within 24 hours the proposal was rejected by Ibn Saud, who maintained his claim to Jabal Naksh and Khor al-Udiad.[35]

The Riyadh Line ran approximately parallel to the Red Line, leaving the Rub al-Khali desert to Saudi Arabia. However, in contrast to the Red Line, it cut off the southern-most portion of the Qatar Peninsula from Saudi Arabia, providing for a meeting of Qatar and Abu Dhabi territories, which deprived the Saudis of access to the sea coast south of Qatar. Apart from that, it claimed more territory for the shaikhdoms in the hinterland and a vast area on the outer edges of Rub al-Khali for Muscat and Oman.

Early in 1949, the dispute between the two governments over boundaries

---

* Before this, a line known as the "Green Line" was suggested by Britain on 9th April, 1935. It ran from the head of Dauhat Salwa south-eastwards to a point about 5 miles north-east of Sikak, then almost due south to latitude 29°N, eventually joining the "Violet Line" at a point to be agreed upon. This proposal was rejected by Saudi Arabia.

was resumed because the Arabian American Oil Company (ARAMCO) personnel were carrying out exploration activities on land in the vicinity of the border. After an investigation, the British Political Officer, on the 22nd of April, handed a written protest to the leader of the ARAMCO party, claiming that they were exploring in territory belonging to Abu Dhabi. Saudi Arabia protested about this a few days later, to the British Embassy at Jeddah. The British answer to that was that if there was any doubt about the territorial rights in the area, it could be removed by discussion between the two governments.

Thus the Saudis agreed to reopen discussion, and negotiations began at Riyadh on the 30th of August. On the 14th of October, as a result of this, the Saudi government proposed the following:

> (a) The frontier between Qatar and the Saudi Kingdom starts from a point at the coast of Dauhat Salwa at 24° 56' North (point A).
>
> (b) From point A the line runs due east until it intersects longitude 51°East (point B).
>
> (c) The frontier runs in a straight line from point B until it reaches the sea coast at latitude 24°48' North (point C), leaving Amirah to the Saudi Arabian Kingdom.
>
> The Saudi Arabian Government consider that the frontier line between Saudi Arabia and Abu Dhabi starts from a point on the Gulf between Bandar al-Mirfa and Bandar al-Maghira, two kilometres east of Bandar al-Mirfa (point A). From this point the boundary runs in a straight line to the south-west until it reaches latitude 23° 56' North (point B). From there it runs due east till it intersects longitude 54° East (point C) and from that intersection it runs in a straight line as far as latitude 24° 25' North and longitude 55° 36' East (point D).
>
> The Saudi Arabian Government consider that these frontiers correspond with reality, having regard to their authority and the authority of Abu Dhabi and relying on the fact that the lands thereby allocated to Saudi Arabia are inhabited by tribes owing allegiance to the Saudi Arabian Kingdom, the Murrah, the Dawasir and other tribes.
>
> As regards what lies to the south and east of the position 24° 25' North and longitude 55° 36' East, this is under the authority of shaikhdoms which are not in treaty relations with the British Government. Therefore, the frontier between the Saudi Arabian Kingdom and these shaikhdoms will be agreed between the Saudi Arabian Government and the shaikhdoms in question. [36]

However, this new claim was rejected by Britain on the 30th of November, 1949, on the ground that it was unrealistic, as the Saudis claimed new territories which belonged to the Trucial Coast in the definition of 1935 (Red Line). Because of this, the British considered themselves to have no option but to take the definition of the Anglo-Turkish convention of 1913-14 as their legal rights.

In the above definition, the Saudis claimed a coast line of about 175 miles from Khor al-Udaid and Mirfa, which was considered by Britain to be part of Abu Dhabi. Moreover, the Saudis claimed a vast area in the hinterland of the Trucial Coast, including the oases of Liwa and Buraimi, leaving the Trucial Coast Shaikhdoms with a narrow strip of land along the coast. Furthermore, it is possible to say that the activities of the oil companies concerned with Oman and the shaikhdoms in surveying the hinterlands of these territories with special attention to the Buraimi region in 1947-8, might have been one of the reasons for Ibn Saud to claim Buraimi as a part of his territory.

In order to renew border negotiations, Amir Faisal, the Saudi Foreign Minister (now King of Saudi Arabia), visited London in 1951. His talks in the British capital resulted in an agreement between the two governments to have a round-table conference, to be attended by the Saudis on one hand, and the rulers of Qatar, Abu Dhabi and a representative of Muscat and Oman on the other. It was also agreed in London that up to the conclusion of the conference, the activities of oil companies on both sides, as well as the movement of Trucial Oman Levies (a British officered force in Abu Dhabi) would be restricted to the area outside the disputed territory.

The round-table conference was opened at Dammam on the Gulf coast in Saudi Arabia on 28th January, 1952. The Saudi Arabian group was under the chairmanship of Amir Faisal, and the others were chaired by Sir Rupert Hay, the British Political Resident in the Gulf. Much of the discussion was concentrated on the historical allegiance of various tribes which roamed the borderland between Abu Dhabi and Saudi Arabia. Collection of Zakat (alms tax) was also frequently invoked as evidence by the rulers to support their respective claims to sovereignty. Thus, on 29th January, Sir Rupert Hay presented the boundary claimed by the Shaikh of Qatar. The line began at Ghar al-Buraid on Dauhat Salwa, and then ran eastward through three points to Hamz Sauda Nathil, and from there through Aglat Manasir to a point on the west shore of Khor al-Udaid. A section of land 25 miles wide at the base of the Peninsula would be regained by Qatar if this frontier was accepted, as the Saudis had claimed it in 1949. Then Sir Rupert advanced the boundary claimed by the Shaikh of Abu Dhabi. This line started at Hamz Sauda Nathil, and ran in a straight line to the most southern part of Sabkhat Matti. From there it ran roughly south-east to al-Quraini then east-north-east to Umm al-Zamul.

However, the two parties did not reach agreement, because the British insisted on taking the 1935 proposal (Red Line) as a basis for their negotiations. The Saudis denied the validity of the 1935 proposal on the grounds that they suggested the line as a compromise, and it had been rejected by Britain, thus becoming a "dead letter proposal", therefore they could not consider it binding to Saudi Arabia.

By mid-February, 1952, the conference had adjourned without reaching agreement.[37]

The Buraimi dispute

In an effort to show authority in the area of dispute, a party headed by Amir Turki ibn Abdullah ibn Ataishan arrived at the Buraimi oasis in August, 1952, sent by the Saudi government. The Amir, who was to act as Governor, was accompanied by a large number of men, doubt about whose occupations caused much dispute. The Saudis claimed that the men were clerks, technicians, attendants and policemen, and numbered only 40, while the British asserted that there were 80 men, 50 of whom were armed troops. To the British this constituted an act of aggression. Also, the Saudis were following a policy which the British deemed to be one of "blandishments and bribes". They had collected reaffirmations of allegiance from 59 tribal chiefs of the Buraimi region, with the promise of others to follow, within a month of the Amir's arrival. To counter these activities, the British sent troops to the vicinity from Muscat and the Trucial Coast, while at the same time, R.A.F. aeroplanes based at Sharjah dropped anti-Saudi literature over Buraimi.

Just when it seemed that fighting must break out, the Saudis sought the good offices of the United States, whose ambassador in Jiddah, Raymond Hare, suggested a "standstill agreement". Both British and Saudi representatives signed this agreement on the 26th October, 1952.[38] Then Saudi Arabia proposed a plebiscite in the area of dispute, but this was rejected by the British, who proposed arbitration instead.

Negotiations were considerably hindered at first, however, by argument over the presence around Buraimi of British-led troops, which the Saudis referred to as a blockade. Eventually, an arbitration agreement was concluded on the 30th of July, 1954, between the British and the Saudis, at Jiddah.

They also agreed to the withdrawal of all tropps from the area, excepting 15 policemen from each side. Saudi oil operations were to be authorised in the south and west of the area of dispute, and British oil operations were to be authorised in the northern part.

In 1955, on the 22nd of January, arbitration proceedings began in Nice. The members of the tribunal were Sir Charles De Visscher of Belgium, who was the chairman, Dr. Ernesto Dihigo of Cuba, Dr. Mahmoud Hasan of Pakistan, Sir Reador Bullard of Great Britain* and Shaikh Yusuf Yasin** of Saudi Arabia. During the discussions both countries stated their cases somewhat lengthily. The British agent informed the tribunal in August that he would be submitting 5 complaints on Saudi violations of the arbitration agreement to the September meeting of the tribunal. The charges were: (1) that there were 4 to 6 men more than the allotted 15 in the Saudi detachment at Buraimi; (2) that the Saudis tried to send arms into the area of dispute; (3) that aeroplanes supplying the post carried passengers; (4) that British relief supplies for fire victims in the village of Hamasa, in Buraimi, did not reach them because of Saudi intervention; and (5) that the Saudis had attempted to bribe some of the Buraimi chiefs.

Regarding the last and most serious charge, the British claimed that a man named al-Quraishi,*** acting for the Saudis, had offered £30,000,000 ($84,000,000) in cash to Shaikh Zaid ibn Sultan, who lived in Hamasa, and was the brother of the ruler of Abu Dhabi, if he would join them.[39] Another version of this states that if Zaid was ready to accept the Saudi terms, they

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* Sir Reader Bullard had a wide experience of the Middle East, and had served as a Minister in Jeddah and Ambassador in Tehran.

** Deputy Foreign Minister of Saudi Arabia.

*** He was a member of the Saudi Arabian Security Service at Buraimi.

would reward him with as much as Rs.400,000,000 from the proceeds of any oil which was discovered in the disputed area.[40]

The tribunal commenced hearings on the British complaints at the session which began on the 11th of September, 1955, and a verdict was expected within a week, either to censure or exonerate Saudi Arabia. But suddenly, on the 16th of September, Sir Reader Bullard, the British member, handed in his resignation, and left, despite the pleas of the chairman, who then also resigned, along with two more of his colleagues. Needless to say, this was the end of the arbitration proceedings.[41]

Sir Reader Bullard issued the following statement with regard to his resignation:-

> I have been shown by the President a copy of the letter which the United Kingdom delegation sent to him today, and I have in the meantime taken very serious consideration of my own personal position as a member of this tribunal. I have always felt uneasy about the position of Shaikh Yusuf Yasin in connection with these proceedings, but I had not realized until yesterday, when Shaikh Yusuf Yasin openly asserted the fact, that he himself was the Saudi Arabian official in charge of affairs at Buraimi, and that he accepted full responsibility for the conduct of Qureishi. Moreover, in the last few days it has become abundantly clear that Sheikh Yusuf Yasin is, in fact, in effective control of the conduct of the proceedings on behalf of the Saudi Arabian government on this tribunal rather than acting as an impartial arbitrator.....
>
> I am afraid the position of the tribunal has been hopelessly compromised by the conduct of Sheikh Yusuf Yasin and by other distasteful matters which have come to notice. I do not think that the tribunal is any longer in a position to reach a unanimous or judicial conclusion on the matter before it, and I feel the only step I can take which is consistent with my own independence and honour is to tender my resignation. 42

On the 26th of October, the British-led forces of the Shaikh of Abu Dhabi and the Sultan of Muscat overran Buraimi, driving out the Saudi police detachment, and occupying the entire oasis. At the same time a note in which Britain proclaimed a new border based more or less on the Riyadh Line of 1935 was handed to the Saudi government. The note also warned against violation of the new line.[43]

The Saudis, of course, protested, and followed protest with condemnation, and a call on the 14th of November, 1955, for neutral supervision of the contested region, from the Arab League's Political Committee. All to no avail. British-led troops remained in Buraimi. Also, the Sultan of Muscat's forces took the town of Nizwa, seat of the Imam of Oman, the religious and secular leader of Muscat-Oman's hinterland, in a movement to strengthen Britain's position in south-east Arabia.[44]

Thus the dispute was ended for the time being, through the use of force by Britain.

The definition and demarcation of southern Kuwait, in 1922 and 1967 respectively, did not give rise to many problems. This cannot, however, be said about the settlement of the frontier between Saudi Arabia and Qatar, the Trucial Coast, and the Sultanate of Muscat and Oman, over which negotiations lasted for many years. Despite this prolonged discussion, no conclusion was reached by the two parties.

No further attempt has been made by either Britain or Saudi Arabia to renew negotiations on the boundary between Saudi Arabia and the Trucial Coast. Obviously this has a profound effect on the exploration for oil. For instance, as mentioned earlier, the work of an ARAMCO exploration party was stopped by Trucial Oman levies based in Abu Dhabi.

The proposed withdrawal of Britain from the Gulf in 1971 may lead to further negotiations on the boundary. Despite this, however, it is very difficult to predict the exact location of the boundary line between the two areas because of the large gap between what Saudi Arabia claims to be its border, and what Britain states it is.

b. Distribution of the Offshore Areas of the Gulf (Continental Shelf)

The ownership of the small, and for the most part, barren islands scattered around the waters of the Gulf is a fairly constant source of contention among the countries surrounding the Gulf. Prior to the discovery of oil, these islands were unwanted, but since then, many opposing claims have been made in various forms. These range from planting flags, which were speedily removed by rival claimants, to building cairns on tidal banks, thus forming new islands. The pearling banks, however, remain unaffected, as no one State has control over them, and they are open to all Gulf countries as far as pearling is concerned. When the oil companies showed an interest in the drilling for oil in the sea, claims increased, and the question of ownership of the sea-bed arose. It became essential for this to be resolved in 1949, as during that year the Rulers of all the States in the Gulf issued declarations claiming jurisdiction over the sea-bed and sub-soil of the Gulf adjoining their territorial waters and extending seawards to undefined boundaries. The granting of concessions off-shore made it necessary to define the areas in which the companies were to work.[45] Here it is intended to look closely at these areas with regard to Kuwait, Saudi Arabia, Iran and Iraq.

On behalf of the Federal Government, President Truman of the United States, on 15th September, 1945, issued a proclamation laying claim to the natural resources of the sub-soil and sea-bed of the continental shelf* of the

* "Continental shelf was considered as sea-bed not exceeding, at its outer limits, a depth of 100 fathoms or 200 metres, (approximately 600 feet)." Such was the definition given unofficially in the United States and officially in Mexico.

The United Nations Law Commission in 1956 defined the term "Continental shelf" as the "seabed and subsoil of the submarine areas adjacent to the =

United States. In this proclamation, President Truman claimed neither sovereignty nor jurisdiction over the natural resources. The proclamation also provided for the possibility of sharing the continental shelf with other states, in which case the definition of the boundary becomes necessary.[46]

In the Gulf, Saudi Arabia was the first state to follow the American example by issuing a Royal Decree on the 28th May, 1949, with regard to the territorial waters of the Kingdom. This was followed by a pronouncement of the same date, claiming the "seabed and subsoil of the Persian Gulf seaward from the coastal sea of Saudi Arabia but contiguous to its coast" as belonging to the kingdom of Saudi Arabia, and saying that it would be subject to Saudi jurisdiction and control.[47]

Although the Saudi pronouncement of 28th May followed generally that issued by President Truman in 1945, it differed in three points: (a) the pronouncement did not mention the term "continental shelf". This might have been due to the shallowness of the Gulf (much less than 100 fathoms); (b) it referred to the areas adjacent to the Saudi territorial waters without limiting how far seawards these areas were to go, and that the boundaries of such areas would be determined in agreement with the neighbouring countries on an equal basis; (c) it put the seabed and subsoil under the jurisdiction and control of Saudi Arabia, instead of limiting its claim to natural resources.

= coast but outside of the territorial sea to a depth of 200 metres, or beyond that limit, to where the depth of the superjacent water admits of the exploration of the natural resources of the said areas."

The International Conference on the Law of the Sea, which took place in Geneva between February 24th and April 24th, 1958, defined the continental shelf as "seabed and subsoil of the submarine areas adjacent to the coast but outside the area of the territorial sea to where the depth of superjacent waters admits of the exploitation of the natural resources of the said areas." (G. Lenczowski, Oil and State in the Middle East, 1960, pp. 130-131.)

This example was followed by the shaikhdoms of the Gulf, with the issue of proclamations almost identical in form to that of Saudi Arabia. These were issued in the following order:-[48]

Bahrain	5th May 1949
Qatar	8th June 1949
Kuwait	12th June 1949
<u>Trucial Shaikhdoms</u>	
Abu Dhabi	10th June 1949
Dubai	14th June 1949
Sharjah	16th June 1949
Ajman	20th June 1949
Umm al-Qaiwain	20th June 1949
Ras al-Khaimah	1949

One possible reason for the issue of these proclamations by the shaikhdoms is that they were encouraged by the hope of discovering oil deposits under the high seas of the Gulf.[49] In order to give a clear picture of the forms of these proclamations, the Kuwaiti proclamation may be quoted as an example.

The proclamation declared that:

> the sea-bed and subsoil lying beneath the high seas of the Persian Gulf contiguous to the territorial waters of the State of Kuwait and extending seawards to boundaries to be determined more precisely as occasion may arise on equitable principles by the Ruler of Kuwait after consulting neighbouring states, appertain to the State of Kuwait and are subject to its exclusive jurisdiction and control.
>
> Nothing in this proclamation shall be deemed to affect sovereignty over the islands or the status of the seabed and subsoil beneath any territorial waters.
>
> Nothing in this proclamation shall be deemed to affect the character as high seas of the Persian Gulf above the seabed and outside the limits of the territorial waters or the status of their air

space above the water of the Persian Gulf outside territorial waters or fishing and traditional pearling rights in such waters.[50]

With the introduction of the above proclamations, the Gulf States claimed large areas of seabed and subsoil lying beyond their territorial waters. Besides, all the 1949 proclamations share common features, which are as follows:

a) They all seem to avoid the use of the term "continental shelf". As in the case of Saudi Arabia, this could be related to the shallowness of the sea, whose depth is much less than 100 fathoms. In contrast, the Iranian draft legislation of 1949, which was passed as law on 19th June, 1955, mentioned the term "continental shelf".[51]

b) The rights of the states along the coast to control and rule certain undefined sections of the high seas outside their territorial waters is recognised with one reservation. This is that the areas claimed shall be delimited with neighbouring states, fairly by agreement.

c) Only the seabed and subsoil will be affected by these proclamations; internationally recognised rights (i.e. fishing, pearling and flying) on the water and in the air above the seabed will remain.

The Iranian proclamation regarding the seabed and subsoil was presented on 19th June, 1955. It claimed that "the areas as well as the natural riches of the seabed and subsoil up to the limits of the continental shelf which extends from the coast of Iran and the Iranian islands in the Persian Gulf and the Sea of Oman belong to the Iranian government and are under its sovereignty."

Iraq was the last state in the Gulf to put forward its claims to sovereignty over the seabed and subsoil of the high seas. The statement of 27th November, 1957, which was very similar in its form to those proclamations made earlier by Saudi Arabia and the Gulf shaikhdoms, defined the Iraqi rights to waters lying beyond its territorial waters. This statement was followed by another on 9th April, 1958. The latter was due to the increased Iranian interest in the offshore zones of the Gulf as shown by their declaration in 1957 that certain zones were open for oil operation.* This act led the Iraqi government to issue a new statement on 9th April, 1958, with regard to its offshore areas. This stated that "oil operations or installations made or to be made in this area of contiguous waters are subject to Iraqi sovereignty, and are not permitted to be carried out except by Iraqi authorities". The statement ended with a warning that the government of Iraq "does not recognise any statement, announcement, legislation or demarcation related to territorial waters or to contiguous waters issued by any neighbouring country which might be contrary to this statement."[52]

Definition of territorial waters

The above-mentioned claims made by the Gulf states with regard to the natural resources of the seabed and subsoil of the high sea areas adjacent to their territorial waters gave rise to the question of the limits of these territorial waters. In 1949, no proclamations were issued by the Gulf shaikhdoms in respect of the definition of territorial waters. It is understood that the usual British limit of three miles (which is now 12 nautical miles) from the low-water mark would appertain to them. But in recent oil concessions the limits of the territorial water was extended to six nautical miles from the coast.[53] Although it may be seen that the offshore extension of Kuwait Oil Company's land concession for Kuwait itself was fixed at 6 nautical miles by the 1951 agreement, the mileage extent of its territorial waters has been officially fixed.[54] On 24th December, 1967, an Amiri Decree was issued by the Ruler of Kuwait which extended the territorial

* On 24th August, 1957, Agip Mineraria (SIRIP) was granted an oil concession in the offshore areas of Iran contiguous to those of Iraq.

waters of Kuwait to 12 nautical miles whether for the mainland or for the islands of Kuwait. The decree also established a starting point from which the coastal sea of Kuwait was to be measured.

In a memorandum which preceeded this decree, it was explained that Iran, Iraq, and Saudi Arabia had officially extended their territorial waters to 12 nautical miles, whereas Kuwait had not done so, except where concession rights were concerned. However, now that Kuwait was a state with all the attributes of sovereignty that went with the position, it was time that the territorial waters were defined.[55]

Saudi Arabia and Iran, the two main coastal states on the Gulf have passed legislation with respect to the definition of their territorial waters. Saudi Arabia presented its earlier official declaration with regard to the breadth of the Saudi territorial waters on 28th May, 1949. Here, the territorial waters were extended seaward for a distance of 6 nautical miles. This distance was altered once again by the Royal Decree of 16th February, 1957. Article 3 of the Decree claims a strip of inland waters between the coasts of the kingdom and shoals or islands stretching seawards for a distance of 12 nautical miles, while in Article 4 it claims that "the territorial sea of the kingdom of Saudi Arabia lies outside the inland waters of the kingdom and extends seaward for a distance of 12 nautical miles." Article 5 gives detailed information about the base-line from which the territorial waters of the kingdom are measured.[56]

According to the Iranian law of 19th July, 1934, the territorial water of Iran was defined as 6 nautical miles from the low-water mark. This was altered on 12th April, 1959, and was extended to 12 nautical miles. Iraq, at the head of the Gulf, issued her decree in respect of territorial waters on 4th November, 1958. In this decree Iraq fixed her territorial waters at 12 nautical miles, extending seawards from the coast. With regard to Iraqi rights over the continental shelf, the Decree states that it "affects in no way the international right which Iraq holds over the two maritime zones called the contiguous zone and the continental shelf situated beyond the limits of the Iraqi territorial sea".[57]

It may be noticed from the above declarations that while the Gulf shaikhdoms were adopting a breadth of territorial waters varying from 3 to 6 nautical miles for the purpose of oil concession, other states such as Iran, Iraq and Saudi Arabia were introducing legislation in order to extend their territorial waters to 12 nautical miles.

It is to be regretted that after some 15 years of concentrated submarine drilling by several oil companies in the Gulf, only a few offshore boundaries have been settled. These are between Saudi Arabia and Iran, Bahrain, and Qatar, and between Qatar and Bahrain, and Qatar and Abu Dhabi.* This problem affects the whole of the Gulf, from Basra in Iraq to the Strait of Hormuz at the Gulf entrance, and there is continuous discussion between Iran and the Arab States on the one hand, and among the Arab States themselves on the other.

At the moment the upper part of the Gulf is of especial interest, particularly in the area where at least three proven or semi-proven oil bearing zones of great potential intersect the putative boundary lines of overlapping oil concessions. This makes each country even more determined to protect its national interests.[58]

The Commencement of Border Disputes:

Pre-announcement of the National Iranian Oil Co. No.228/15

On 1st April, 1963, N.I.O.C. announced via Plat's Oilgram News Service that two areas (District I) of continental shelf of the Gulf adjacent to the

* To date, Britian has conducted negotiations on behalf of the states of the Trucial Coast, as they are still British Protectorates.

Iranian mainland would be open for international bidding with effect from 1st July, 1964.[59] Area 1 of District I, relinquished recently by I.P.A.C., originally comprised an area of 720 square miles, but it was extended by the addition of 380 square miles. It now extends well to the west of the original I.P.A.C. concession. It is the latter extension that appears to have cut into Iraqi territorial waters in the north, and the Shell Kuwait concession in the south.[60] (See Fig. 5.) Area ii of District I is located to the south of the I.P.A.C. concession, but is separated from it by a wedge of some 10-15,000 square kilometres of water.[61]

The Iranian pre-announcement of 1st April, 1963, provoked diplomatic protests against Iran from the Arab States. The Iraqi government, in its statement dated 1st May, 1963, stated that since "most of the areas declared open (for bidding) are exclusively Iraqi territorial waters,* it will not recognise, nor permit, any concession granted to any party whatsoever for oil exploration in these areas..... All the parties concerned must ascertain the ownership of the areas before seeking to grant or acquire any exploration concessions in them...."[62]

The Kuwaiti government, in its statement of 4th June, 1963, described the Iranian pre-announcement as a violation of its territorial sovereignty. In addition, the statement declared that Kuwait had already fixed its continental shelf boundaries when she granted a concession to Shell Co.[63]

On 15th June, 1963, Saudi Arabia followed the example of Iraq and Kuwait by issuing a statement protesting about the delineation of Area ii of District I (south of I.P.A.C. concession) declared in the Iranian pre-announcement of 1st April, 1963. In addition, the statement also did not recognise the delineation of the Pan American Petroleum Corporation (I.P.A.C.) concession

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* Possibly the government is referring both to Iraq's territorial waters and the continental shelf.

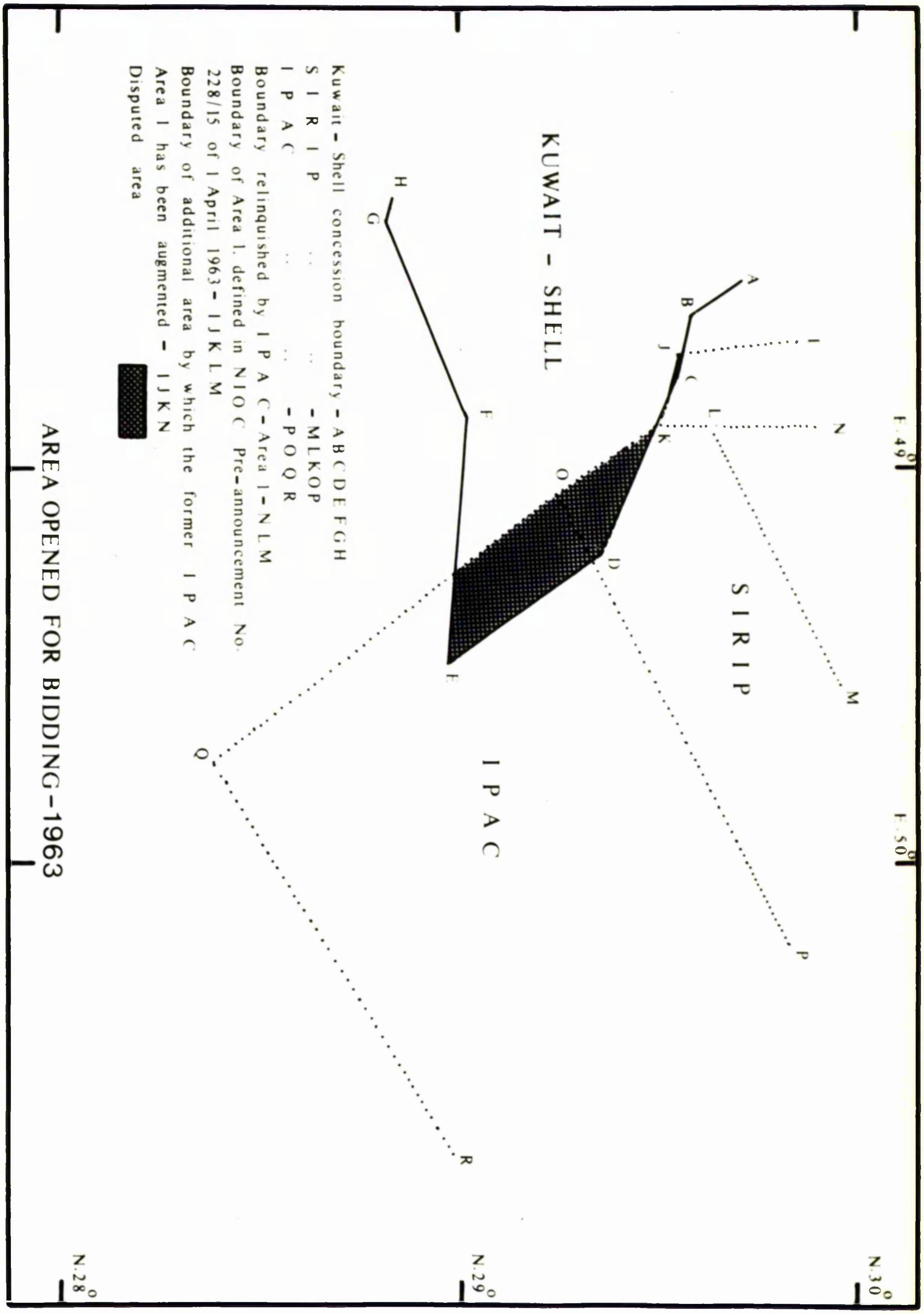

Fig. 5 - Area I of District I opened for bidding by the National Iranian Oil Company on April 1st, 1963.

area on the ground that this constituted an "infringement of the legitimate rights of Saudi Arabia to the natural resources in the off-shore area opposite Saudi Arabia's territorial waters or the territorial waters of the Saudi Arabia-Kuwait Neutral Zone."[64]

Definition of the overlapping areas

The overlapping concession areas that have provoked the afore-mentioned claims and counter claims may be described as follows:- *

Iraq-Iran The area in question is Area 1 of District I. This zone, which comprises some 1,100 square miles, extends northwards to within three miles of the coast and southwards to the limit of SIRIP's offshore concession area.[65] The Iraqi government claims that Area 1 as defined by Iran in the pre-announcement of 1st April, 1963, infringes upon her territorial waters at the head of the Gulf. **[66]

Kuwait-Iran Kuwait claims that its offshore areas, where a concession has been granted to Shell, are infringed upon by Iran's Area 1. At the same time Iran claims that Shell's concession cuts into offshore areas on the Iranian side held by SIRIP and IPAC under concession granted in August 1957 and April 1958 respectively.***[67] (See Fig.6.)

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* For a full description of these disputes see M.E.E.S. Suppl. No.11, 18th January; No.31, 7th June; Suppl. No.32, 14th June; and No.33, 21st June, 1963.

** There has always been confusion over the ownership of the offshore area at the head of the Gulf, though this has never yet given rise to serious dispute. Both Iran and Iraq lay claim to territorial waters extending 12 miles from their coasts, plus contiguous waters.

*** It may be noted that Kuwait-Shell Co., which holds Kuwait's offshore concession, had informed Kuwait of its decision to suspend its drilling operations within the concession area pending the settlement of the Kuwaiti-Iranian border dispute. The Company informed the Kuwaiti government that "its best drilling prospects lie in the south-eastern part of the concession, nearer to IPAC's Cyrus discovery. However, drilling in this area will not be possible until some agreement is reached between Kuwait and Iran on the offshore boundary". See M.E.E.S., No.51, 25th October, 1963.

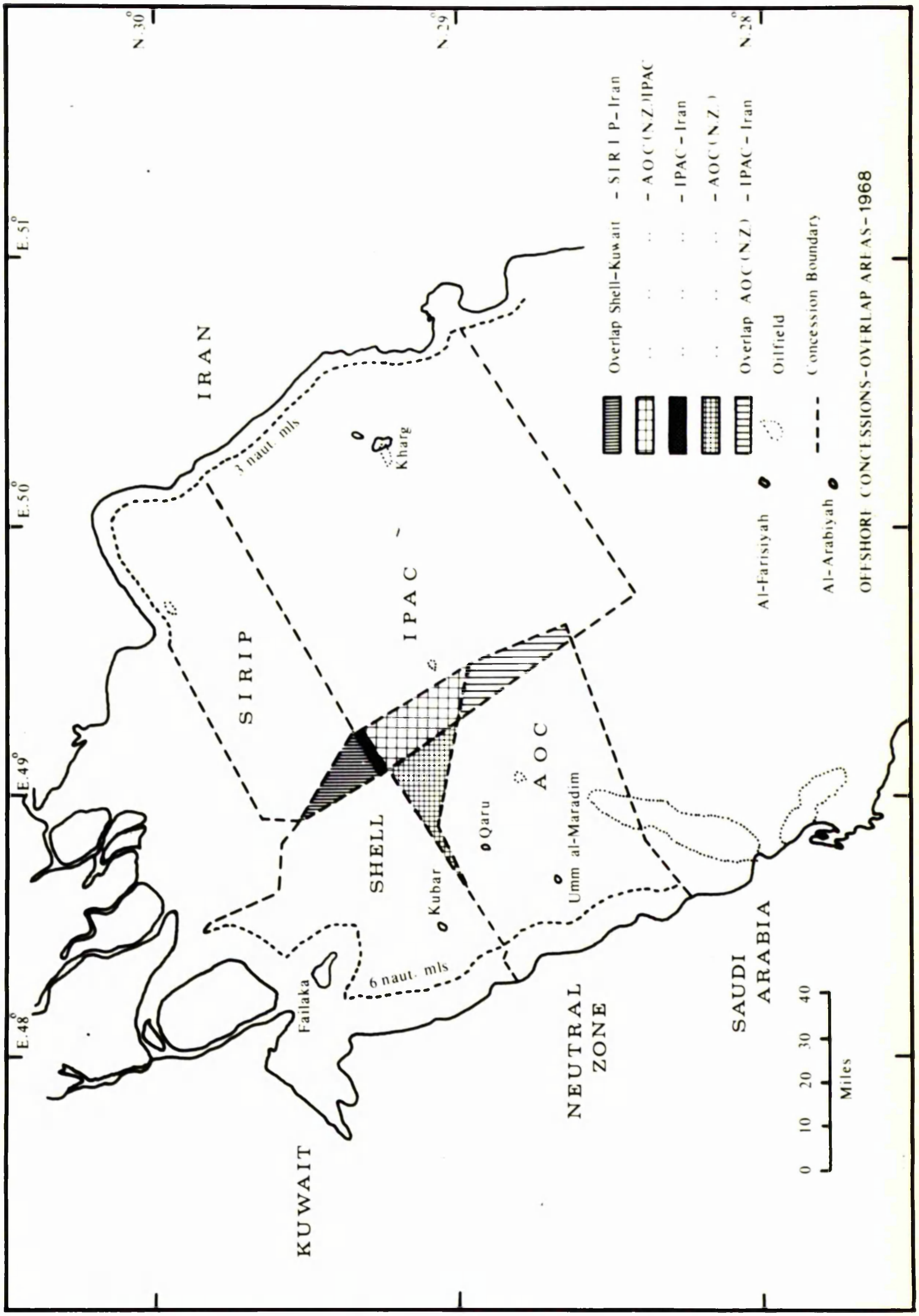
OFFSHORE CONCESSIONS-OVERLAP AREAS-1968
IRAN
KUWAIT
NEUTRAL ZONE
SAUDI ARABIA
SIRIP
IPAC
SHELL
AOC
Failaka
Kharg
Kubar
Qaru
Umm al-Maradim
Al-Farisiyah
Al-Arabiyah
3 naut. mls
6 naut. mls
Overlap Shell-Kuwait - SIRIP-Iran
Overlap AOC(N.Z.) - IPAC-Iran
Oilfield
Concession Boundary
Miles
0 10 20 30 40
E.48°
E.49°
E.50°
E.51°
N.28°
N.29°
N.30°

Fig. 6

Saudi Arabia/Kuwait Neutral Zone - Iran Saudi Arabia claims that the IPAC concession of 1958 cuts into the offshore of the Neutral Zone where a concession in respect of the Saudi half interest was granted to A.O.C. in 1957.*[68]

Saudi Arabia - Kuwait The definition of the offshore of the Neutral Zone's most northerly boundary is the prime factor in the Kuwait-Saudi controversy which arose from the Kuwait Shell concession agreement of 1961. Thus the area in question, which Kuwait has allocated to the Kuwait Shell concession area, is said by Saudi Arabia to constitute an overlap with the Neutral Zone 1957 concession area. The problem appears to have stemmed from the difference between the definition of the concession area given in the Saudi Arabian agreement of 1957 with A.O.C., and that given in the Kuwaiti concession agreement of 1958 with the same company. The concession area granted by Saudi Arabia to A.O.C. extends further northward. This area of difference is reported to be of great production potential, which makes it important to both countries.[69]

Saudi Arabia-Iran The prolific Fereidoon field is the scene of yet another overlap between the concessions of IPAC in Iran and ARAMCO in Saudi Arabian waters. Fereidoon, which was discovered by IPAC in 1966 is believed to have production from three horizons. The Middle Cretaceous Burgan Sands (27° A.P.I.), the Lower Cretaceous Yamama limestone, and the

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* It is interesting to note that oil was proved in the disputed area by drills of both A.O.C. and IPAC. In the beginning of 1966, Esfandiar oil field on the Iranian side, produced oil from the Lower Cretaceous Ratawi limestone formation at a depth of about 9,000 feet. Subsequently, in February, 1967, in a well drilled by A.O.C. on the Neutral Zone side, Lulu No.1, oil was found in the same structure at the same depth. Both wells are reported to have an output of about 30,000 b/d with an A.P.I. ranging between 30° and 34°. See M.E.E.S. No.16, 16th February, 1968.

Upper Jurassic Arab Zone (38° A.P.I.). This is the field from which ARAMCO was ordered to move by the Iranian Navy on the 1st of February, 1968, while preparing to drill apparently within the borders of its own concession area.[70] However, Saudi Arabia claims that its offshore areas, held under concession by ARAMCO since 1948, are infringed upon by both the IPAC concession of 1958 and Area II of District I as defined in the Iranian pre-accouncement.[71]

<u>The negotiation process on the settlement of the offshore boundaries</u>

Representatives of Saudi Arabia, Iran and Iraq, in their meeting in Geneva in October, 1963, reached an understanding on the settlement of offshore demarcation of the Gulf. No Kuwaiti representatives were present at the Geneva meeting, but it was hoped that Kuwait would agree to the understanding reached by the above countries.[72]

Soon afterwards, in November, 1963, Iranian delegates arrived in Iraq to discuss the question of the delimitation of the offshore boundaries between the two countries. In conclusion, the two governments agreed on "a basis for joint exploitation of oil in the disputed areas, whereby the interests of both parties would be observed".[73]

In April 1964, Iran announced its intention of beginning negotiations with Kuwait and Saudi Arabia about the settlement of the offshore demarcation in the Gulf. The Iranian intentions were realised when its Foreign Minister paid visits to both Kuwait and Saudi Arabia. Consequently, Kuwait and Iran issued a joint communiqué on 2nd April, 1964, in which they agreed to establish a joint committee of specialists in order to study the matter and to reach a final settlement in respect of the division of the continental shelf. Discussions were held with regard to offshore demarcation on 6th April, 1964, between the Iranian Foreign Minister and Saudi officials. As a result, it was agreed that an exchange of delegates should take place in the near future to define the boundaries of the offshore areas between the two countries.[74]

Ever since then, negotiations between Iran and the Arab States on the definition of the offshore boundaries have continued. The main problem is the difficulty in finding an equitable basis for working out the Gulf median line which should more accurately separate those areas of natural resources claimed by Iran from those claimed by the Arab States.* When agreement has been reached it could become possible for both Iran and the Arab States to reconsider the boundaries of the concessionary areas of their respective oil companies, on either side of the line, and to determine them. These would be settled according to the delineation settlement reached among themselves.[75]

Only those agreements between Iran and Kuwait, and Iran and Saudi Arabia will be discussed here.

i) <u>The offshore boundary agreement between Iran and Saudi Arabia</u>

On the 13th of December, 1965, representatives of the governments of Saudi Arabia and Iran initialled an agreement relating to the definition of the boundary line separating the submarine areas belonging to Saudi Arabia from

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* The Geneva Convention of 1958 laid down the international legal principles controlling the demarcation of continental shelf boundaries between states whose coasts are adjacent or opposite to one another. Though this convention was never ratified (probably because of its failure to agree on the establishment of a world limit for the breadth of territorial waters) and its principles are somewhat vague, it is useful as a guide and starting point for discussion. Article 6 of the Convention stipulates that the continental shelf boundaries between these states "shall be determined between them". In cases of non-agreement and "unless another boundary line is justified by special circumstances", the boundary where the states are opposite each other is "the median line every point of which is equidistant from the nearest points of the baselines from which the breadth of the territorial sea of each state is measured". Where the states are adjacent the boundary is determined "by application of the principle of equidistance from the nearest points of the baselines from which the territorial sea of each state is measured". Iran, Saudi Arabia and Kuwait have all agreed in general that the median line principle of the convention should be applied to negotiations between them. However, offshore islands =

those of Iran. The agreement also provided a solution to the long-standing dispute over the ownership of the two islands of al-Arabiyah (50°10'23"E, 27°45'49"N) and Farsiyah (50°9'48"E, 27°48'22"N), by recognising Saudi sovereignty over the former, and Iranian sovereignty over the latter.[76]

One of the agreement's main factors was that the Iranian island of Kharg, which is 23 miles from the coast, should be given "half-effect" status in fixing the boundary line.* This was a compromise between the Saudi Arabian requests for a shore-to-shore median line and the Iranian claim for "full-effect" status for Kharg Island.

However, the Iranians never ratified this agreement. The probable reason for this appears to have been that the disputed areas, which was where the concessions of IPAC (Iran) and ARAMCO (Saudi Arabia) overlapped, contained a very large oilfield. The Iranian portion of the field (the "F" structure, subsequently named the Fereidoon Field) was discovered by IPAC in early 1966. IPAC extended its activities to drill at least another six wells in the disputed area, west of the Kharg half-effect line. On the Saudi side, ARAMCO found oil in the same structure, and the field was called Marjan. Furthermore, from evidence available, it seemed to the Iranians that the greater part of the "F" structure lay in Saudi waters west of the Kharg full-effect line.[77]

= are not referred to, and the weight which should be given to them in determining the baselines is not settled. It is precisely the question of the status of islands (Kharg off Iran, and Failaka and Kuber off Kuwait) that has been the cause of the trouble in the demarcation talks. (Middle East Economic Survey, No.16, 16th February, 1968.)

* The Iranians, in their negotiations with Saudi Arabia, considered Kharg Island to be a suitable candidate for a median line basing point for several reasons. Firstly, that the island could not be regarded as barren and waterless; secondly, that it was a major export terminal; and finally, that it was connected to the mainland by a 30 inch pipeline. Thus, it should have been regarded as a part of the mainland. (Middle East Economic Survey, No.16, 16th February, 1968.)

It would appear, therefore, that the Iranians had not fully considered this proposal at first, but after studying its effects more carefully, they realised that the Fereidoon Field would be more or less outwith their boundaries, thus they decided against signing the agreement.

Once again, in order to reach a settlement in respect of the demarcation question, the Saudi and Iranian negotiators adopted a new approach to the problem by avoiding the degree of status to be given to Kharg Island in determining the boundary line. The new approach was to divide the recoverable oil reserves in the disputed oil-rich zone, on the basis of available seismic and drilling data. This was regarded as a possible and appropriate compromise solution to the problem. Subsequently, as a result of a series of talks held in Saudi Arabia and Iran, an agreement was signed in Tehran on the 24th of October, 1968, by the Saudi Oil Minister, Ahmad Zaki Yamani, and NIOC chairman, Manuchehr Eqbal.[78] Briefly, the provisions of the agreement were as follows:-

Article I of the agreement provides for the "sovereignty of Saudi Arabia over the island of al-Arabiyah and of Iran over the island of Farsiyah." Furthermore, the above Article provides for territorial waters of 12 nautical miles for each island, "measured from the line of lowest low water" on each island. In the case of territorial waters overlapping, "a boundary line separating the territorial seas of the two islands shall be drawn so as to be equidistant throughout its length from the lowest low water lines on each island."

Articles 2 and 3 provide that "except in the vicinity of al-Arabiyah and Farsiyah..... the boundary line separating the submarine areas which appertain to Saudi Arabia from the submarine areas which appertain to Iran shall be..... determined by a straight line" the points of which were specified, and that each party would recognise the sovereignty over the seabed and subsoil, of the other on its side of the line. (See Fig.7.)

Article 4 of the agreement prevents both parties from carrying out drilling operations "within a zone extending 500 metres in width in the submarine areas" on both sides of the boundary line. (The zone to be measured from the boundary line.)[79]

ii) Iran-Kuwait offshore verbal agreement

The concessions for the head of the Gulf have been granted to several oil companies, among which are Kuwait/Shell on the Kuwaiti side, and SIRIP and IPAC on the Iranian side. These companies have surveyed various sections of their concession areas, and it has been concluded by them that the area is potentially rich in oil. In particular, after extensive surveys had been made, the Kuwait/Shell Oil Company believes strongly that oil is to be found in the south-eastern part of its concession area. However, this is the area in dispute, referred to as the "Golden Triangle", and as a result of this dispute, Kuwait/Shell has suspended operations in the area since 1964 while awaiting a solution. Thus the area is important to both Iran and Kuwait, making settlement vital if the resource is to be utilised.

During the Ruler of Kuwait's state visit to Iran in mid-January 1968, a joint communiqué was issued to the effect that Iran and Kuwait had arrived at a "final solution to the continental shelf question in respect of the offshore areas of the two countries". Details of the agreement have not yet been officially released, beyond those mentioned in the announcement. However it is understood that the basic principles of the solution included the acknowledgement of full-effect status in determining the median line for certain offshore islands including Failaka on the Kuwaiti side, and Kharg Island on the Iranian

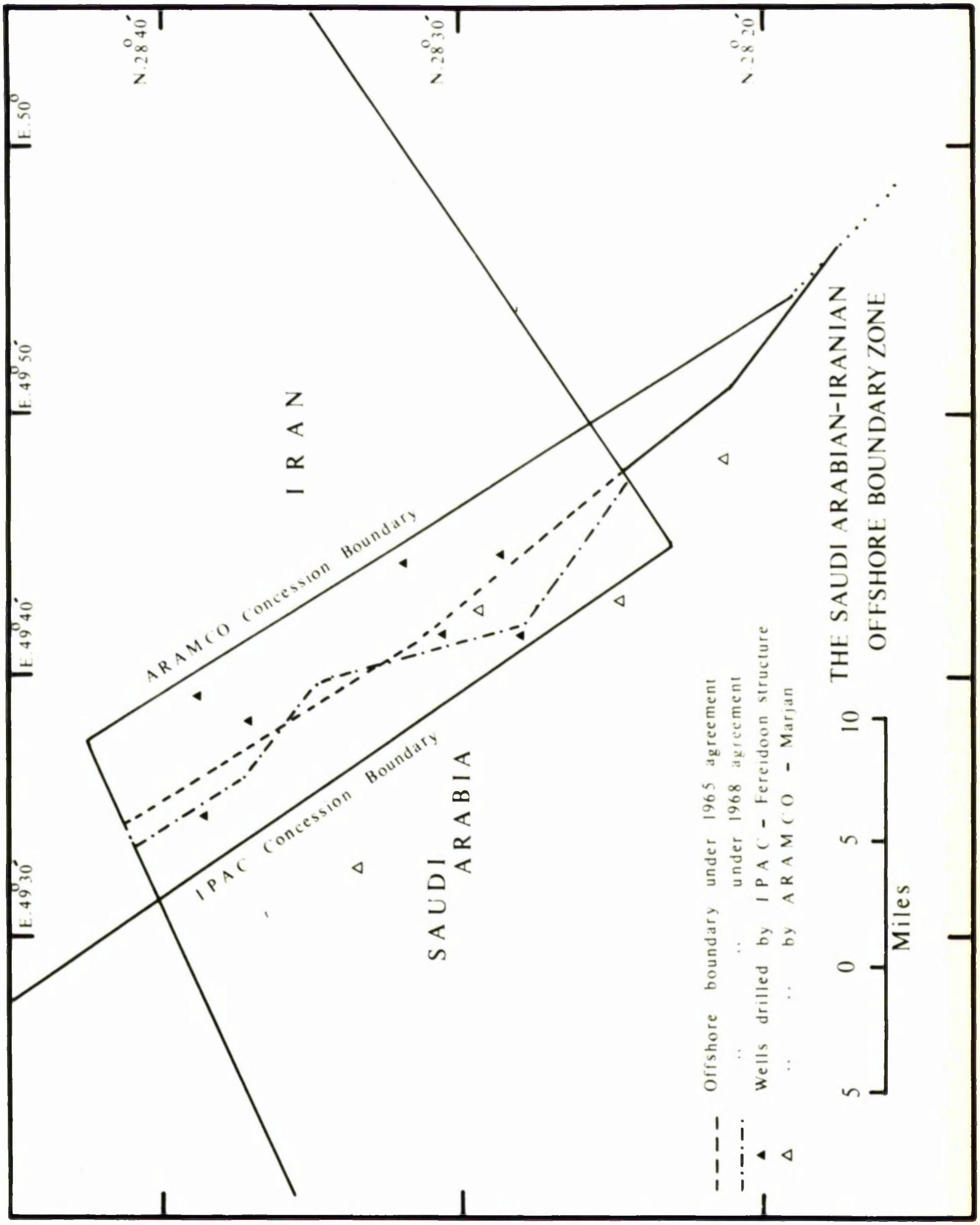

Fig. 7 - IPAC concession overlapping that of ARAMCO, and the boundary line separating the Saudi Arabian section of the Gulf from that of Iran.

side.[80]

The Kuwait-Iran agreement was less than two months old, and not even ratified when the Iraqi government objected to it in March, 1968. The Iraqis protested on the grounds that they had not been consulted about the agreement, although they considered that they had rights in the matter. The Iraqi Foreign Minister issued a statement on the 25th of February, 1968, emphasising the Iraqi refusal to recognise "any statement, proclamation, legislation or demarcation affecting Iraq's territorial waters and continental shelf which is issued by a neighbouring country and which infringes the rights and sovereignty of Iraq in respect of the area in question".[81]

To conclude, it is beyond doubt that the boundary settlement, either on land or offshore, creates a great problem for the concerned countries in the upper part of the Gulf. So far, little has been done to solve this problem. Still in the case of onshore boundary definition, the problems between Kuwait and Iraq, and Saudi Arabia and the Trucial Coast have high priority. Offshore demarcation between Iran and the Arab States is not less in its complexity than the on-land problem. Finding the solution to these problems will require both time and patience from the parties concerned, and International Law holds no effective remedy as yet. The dispute has to be solved by direct government to government talks in each case, and from this means of settlement, little can be expected.

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CHAPTER II

HISTORICAL GEOGRAPHY OF OIL EXPLOITATION AROUND THE GULF

The above heading will be analysed in two sections:

(1) The earliest oil exploitation (especially in the Gulf area);

(2) The modern phase - inland and offshore concessions.

The first section will deal with the utilisation of oil in ancient times, and the way it was obtained. Furthermore, it will show how petroleum became important in the nineteenth and the early part of the twentieth century, as one of the main sources of energy.

In the second section, it is intended to examine the details of the concessions under which the oil has been exploited, and the terms of the concessions, as well as the volume of oil extracted.

1. Earliest oil exploitation

Although the Middle East has become one of the main world oil suppliers quite recently, petroleum has been known and used there for many years.

Results obtained from the work of archaeologists in different parts of the Middle East indicate that petroleum served many purposes. For example, in Sumarian times (that is some 5 or 6 thousand years ago), bitumen was used as bonding material (particularly at the city of Ur in Mesopotamia), fixing the blades of tools into handles, and for sticking jewels into settings.[1] It was also utilised in the paving of the Hanging Gardens of Babylon and in the plumbing and drainage of the city.[2]

It is beyond doubt that petroleum gas played an important role in the religion of the ancient Persians as fuel for the "eternal" fire which they venerated. They constructed many of their temples over places where petroleum gas escaped from the ground, in order to use the escaped gas as a constant inexhaustable fuel supply. Such temples were found at Baku,* and near Damghan (180 miles east-north-east of Teheran, Masjid-Sulaiman, and elsewhere.[3]

Other important values attached to petroleum in ancient times may be found in the inscriptions which record that in about 1500 B.C. Thothmes III, Pharoah of Egypt, extracted a tribute of bitumen from certain cities. This material was used in the preparation of mummies.[4]

Aristotle , Pliny, and other ancient Greek and Roman authors also mentioned petroleum in their writings. Marco Polo, in the thirteenth century, made reference to camels being anointed with petroleum against mange. It was also used by the people of India, Burma, and the East Indies for the purpose of building, waterproofing, and as a source of lamp oil.

In North America, the Indian tribes collected it from natural springs for centuries and prized it highly for medicinal purposes. In Central America, the ancient Mexicans found that bitumen could serve as chewing-gum.[5]

In more recent times, as early as the thirteenth century A.D., Persians used oil for artificial lighting.[6] Thus, it is possible to give numerous examples of the way oil was utilised throughout past centuries.

With this long association with petroleum, the Middle East naturally was regarded as a likely source of oil supplies when the modern oil industry came into being in the latter half of the nineteenth century.

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* This place and its oilfields were for many centuries within the confines of Persia.

As mentioned previously, petroleum collected from seepage has been used for many centuries. However, it was not until August 27th, 1859, that the first attempt was made to drill specifically for oil by Colonel Drake at Titusville, Pennsylvania. Drake succeeded in finding oil at a depth of 69½ feet. The well was not considered to be a large producer, but the amount was enough to launch an industry which is now among the world's largest.[7]

However, Drake's discovery preceded intensive drilling throughout the United States. This was followed by intense competition among thousands of oil producers, and between the producers and the marketers, which led to bitter conflict and to much wastage of gas and oil. Gradually, however, the foundation for a more orderly and scientific industry was laid, and the petroleum industry grew steadily.

Within a decade, Drake's example was followed in Russia, Rumania, Canada, and Italy. 1900 showed oil discoveries in Poland, Japan, Germany, India, Peru, and the Dutch East Indies (now Indonesia). In 1908, Iran was among such countries as Mexico, Argentina, and Trinidad in discovering oil in commercial quantities. It was the first country in the Middle East to do so, at the site of Masjid-i Sulaiman, which is still producing oil. The next significant find was in 1927 at Kirkuk in Iraq, and the 1930's brought further oil discoveries in the Arabian Peninsula.

The rapid expansion in the oil industry was caused by increased domestic and industrial needs. Before the nineteenth century, animal and vegetable fats and oils were adequate to serve all purposes, but thereafter proved inadequate to cope with more sophisticated demand.

For example, in the nineteenth and early twentieth century, kerosene was the principal petroleum product, mainly used for lamps and stoves, while gasoline and lighter products had no commercial uses and were normally dumped or burned. With the development of the internal combustion engine and the subsequent growth of the automotive industry, gasoline became important and acquired a fair share of the oil market. Thereafter, oil refining was changed from a relatively crude process to a highly sophisticated operation.

World War I also had great influence in increasing oil productivity. Development occurred in engines, especially in the field of heavy transport equipment, tanks and aeroplanes. This was followed by the conversion of the world navies, and then merchant fleets from coal to oil.

The Russian revolution also affected oil development throughout the world. In 1900, Russian output and exports accounted for more than half of the world's oil. Their withdrawal from the oil market after the revolution in 1917 created a shortage in oil supplies. This was soon replaced by increased production in Venezuela and Iran.[8]

During World War II, the Middle East oil industry was hampered by transportation problems, although some of its oil fields, such as those of Iraq and Saudi Arabia, were utilised to a certain extent to supply the Allies, while those of Iran were fully utilised. By the end of the War, international oil companies again turned their attention to the Middle East, and they developed areas where previous explorations had revealed vast quantities of crude oil (e.g. Kuwait). Since the war, the Middle East oil industry has seen great progress, and at present it counts as one of the main sources of world oil supply.

2. The modern phase - inland and offshore oil concessions

The development of oil exploitation in the Middle East has been made possible through the investment of foreign capital, and this involved Middle Eastern countries in international politics. These countries have at different times, signed oil concessions with a number of oil companies from various countries. The system of concessions in these countries (Iran, Saudi Arabia, and Kuwait), differs from that in the United States, where the rights of subsoil are owned by the Federal Government, State Government, and individuals.

In places where the Government regards itself as the owner of petroleum resources, concessions have been granted in order to exploit oil resources. Concessionaires were thus permitted to exploit the oil. They paid a percentage of their net profit to the host government, and thus were exempt from customs' taxation and other duties. The D'Arcy concession was one of those, and paid 16% of the company's profits to the Iranian Government. Such concessions were granted in the early twentieth century.

This system was later changed for another. Instead of paying percentages of the net profit, the concessionaires paid royalties per ton of oil produced and exported. The companies were still, however, exempt from taxation.

After World War I, this type of concession became common in the Middle East, and the 1933 Iranian concession was of this nature.[9]

In colonies and protectorates, the situation was different. The governments of these countries could not grant concessions without the approval of their parent countries, and these, naturally, preferred to grant concessions to their own people.

Venezuela was the first country to improve on these conditions. In order to increase her income from oil production, she introduced the system of sharing 50-50. Saudi Arabia followed this example, then the rest of the Middle East.[10]

In order to deal with the governments of Iran, Saudi Arabia, and Kuwait, with reference to their concession agreements with international oil companies, each country will be discussed separately. The reason for this is that the type and terms of the Iranian agreements with the operating oil companies differ in many cases from those granted by Saudi Arabia and Kuwait.

a. Iran

D'Arcy Concession

As the nineteenth century drew to a close, the international oil industry was dominated by the American companies and mainly by the Standard Oil Company. They believed that there were abundant oil reserves in the United States, which in turn led the companies to think less of obtaining concessions for new oil deposits than of acquiring more overseas markets for American oil. Also, entry of non-British prospective concessionaires to the Gulf area was made difficult by the British Government, thus further isolating the Middle East.

In the early 1890's Jacques de Morgan headed a scientific mission sent to Persia by the French Government. Among their archaeological reports were those showing significant indications of oil seepages. In February, 1892, the results of the investigations were published in Annales des Mines.[11] This, and other technical notices, came to the attention of William Knox D'Arcy, who had made a fortune goldmining in Australia. In 1900, he formed a small group (his own assistant, A.L. Marriot, a French ex-diplomat, and a Persian-Armenian), and set them to work in Tehran to obtain an oil concession. On May 28th, 1901, D'Arcy was granted a concession by the Shāh Muzaffar ed-Din.*[12] At this

* Zuhayr Mikdashi, in his book, "A Financial Analysis of Middle Eastern Oil Concessions (1901-1965)" elaborates: "social unrest, corruption of the administration, foreign political influence and arbitrary rule of ignorant leaders" were dominating the country at the time when the D'Arcy concession was granted.

time neither the concessionaire nor the government had any idea of the future of oil exploitation in Persia, and the science of petroleum had by no means reached today's standard to be able to assess the future of petroleum. The financial backers were ready to gamble their money on the existence of oil in Persia.[13]

The D'Arcy concession provided for the exclusive privilege of exploiting the hydrocarbon resources of Persia, with the exception of the five northern provinces, (i.e. Azerbaijan, Mazandaran, Gilan, Astrabad, and Khorasan), the right to build pipelines to the Gulf Coast, and it included exemption from taxation and customs duties. (See Fig. 1A.) It covered an area of 500,000 square miles for a period of sixty years beginning from May 28th, 1901. The holder of the concession had to form a company (or companies) within two years, and when the first one was established, was to pay £20,000 ($97,580) in cash, and another £20,000 in paid-up shares to the Persian Government. Also, 16% of the annual net profit was to be paid as royalty* to the Persian Treasury.[14]

It is possible to say that the main reason for connecting the payments to the Government of Persia with profits from trading was to protect, to a certain extent, the concessionaires, should they make little or no profit, or even sustain a loss in any year. In this event the company was not expected to pay anything to the Government, which, however, paid nothing towards a loss. Naturally the Government hoped that the industry would always be prosperous, which was not the case. Thus the Government's income from oil did not comply with its aim of acquiring a regular source of public revenue.[15]

Two areas were selected by D'Arcy from the total as likely to contain oil deposits. One was Chah Surkh near Qasr-i-Shirin, close to the Iraq-Iran

* A payment of royalty calculated either on the basis of volume of oil produced, sold or exported, or on the basis of profits, or both.

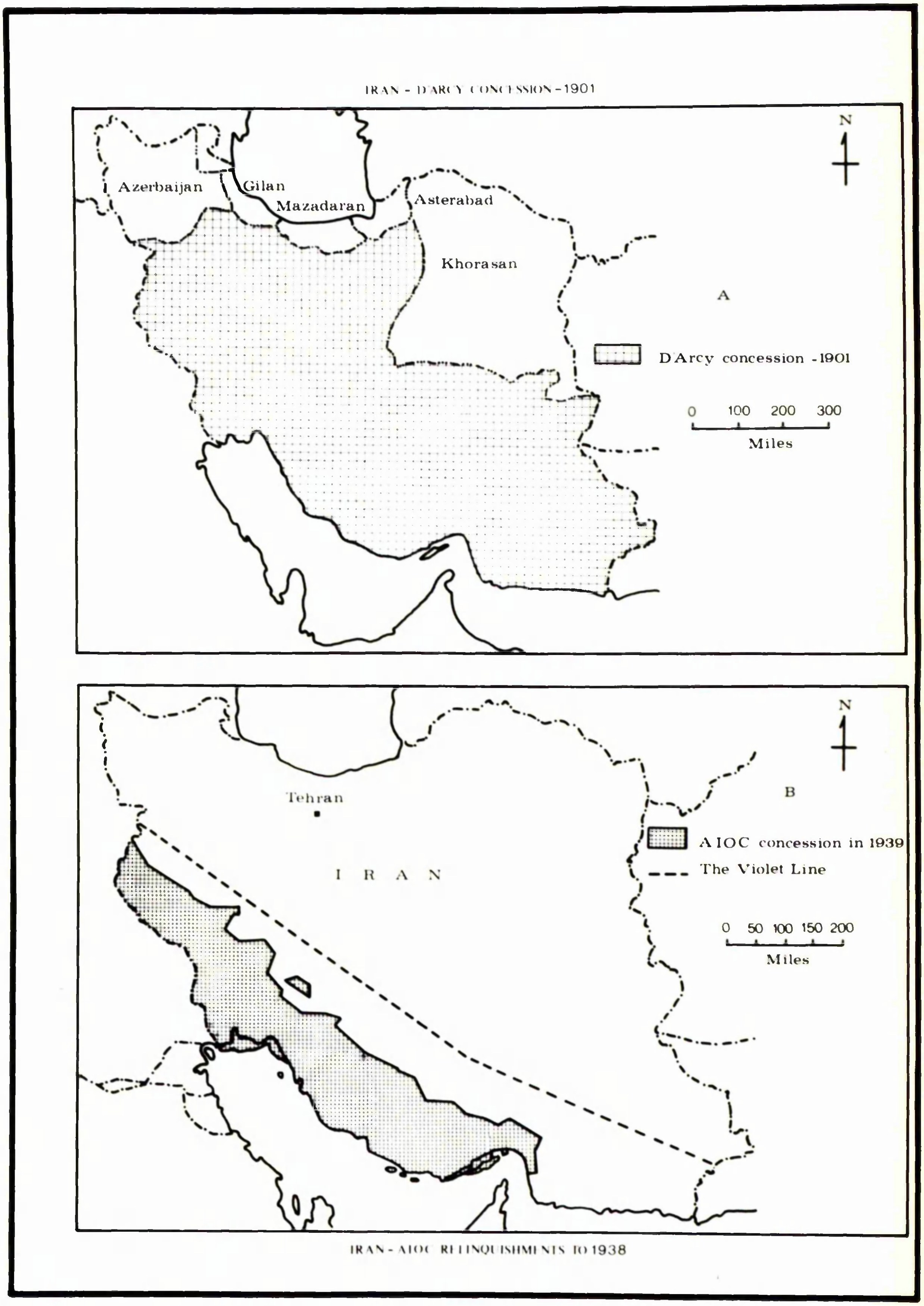

Fig. 1 - A D'Arcy Concession Area of 1901.
B The territory of the Anglo-Iranian Oil Company concession, which until 1938 comprised all the area south of what was known as the "Violet Line". Since that date, the concession has consisted of the areas shaded to the south of the "Violet Line".

border, and the other was in the south-west, to the east of Ahwaz city.[16] In 1902, D'Arcy began drilling at Chah Surkh, with G.B. Reynolds supervising the operation. At the end of 1903, the First Exploration Company was registered. Opinion differs as to the amount of capital it started with, the range being from £400,000 ($1,947,200) to £600,000 ($2,920,800).* In 1903 and 1904 respectively, wells Nos.1 and 2 were drilled and proved to contain oil at an approximate depth of 1,665 feet. Unfortunately the output of 180 barrels per day fell rapidly to 25, and production of this order made it pointless to construct a pipeline to the coast of the Gulf.

As D'Arcy by this time had spent about £300,000 ($1,461,600) from his own resources, they were now somewhat strained, and he was reluctant to further burden them. Lord Strathcona and the Burmah Oil Company were persuaded by the British Amiralty to co-operate with D'Arcy and prevent the concession from falling into non-British hands.**[17] As a result, in 1905, Concession Syndicate Limited was formed, and this took over the First Exploration Company and the D'Arcy concession, and established itself financially. In 1905, the first work of the Syndicate was to remove the drilling apparatus from Chah Surkh to the south-west, where the semi-autonomous Bakhtiari tribesmen lived.*** Two areas were selected with 80 miles between them. One was in Mamatain, and the other was Maidan Naftoon (Masjid-i-

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* John Marlowe in his book, The Persian Gulf in the Twentieth Century, mentions a sum of £400,000, p.80, and Fathulla Sa'adat, in Geghrafiyaye ektisadiye nafti Iran (Economic Geography of Oil in Iran), mentions £600,000, p.114.

** Other investors from Europe and America approached D'Arcy, and those from Germany especially were willing to buy the concession, and even to cover his expenses. D'Arcy, however, was not interested.

*** To compensate the Bakhtiaris for their grazing and other land used by the company, and to enlist their co-operation, the chiefs were promised a 3% ownership interest in all companies to be established to exploit oil resources in their district, plus £3,000 annually, beginning in 1905, for the safeguarding of property and the pipelines.

Plate 1 - Iran's first producing oil well - Masjid-i Sulaiman

Sulaiman). Between 1905 and 1907, two wells were drilled at Mamatain to a depth of 2,000 feet, but they did not prove to be productive. In 1907, drilling facilities were moved to Maidan Naftoon, and the first well proved productive at a depth of 1,100 feet (or 1,180 feet), on May 26th, 1908.[18]

Discovery of oil in commercial quantities at Masjid-i-Sulaiman led to the establishment of the Anglo-Persian Oil Company on April 15th, 1909, with the object of taking over the First Exploration Company and the D'Arcy concession. The initial capital of the Company was £2 million ($9,752,000) which was largely held by the Burmah Oil Company.

Further investigation in the Masjid-i-Sulaiman area confirmed the existence of large oil deposits. Anglo-Persian, however, had little capital left, and could not have developed these resources without the help of the British Government, which bought a controlling interest of about 56% in 1914, supplying the company with £2,200,000 ($10,727,200) and leaving Burmah Oil with about 26½% of the ordinary shares.*[19]

The provisions of the D'Arcy concession led to disagreement in 1920, between the concessionaires and the host Government, with regard to (a) "revenue payments", (b) "security obligations of the Persian Government", (c) the right of the Persians to share the profits made by the subsidiaries of the Anglo-Persian Oil Company (APOC) and on various other counts. On the other hand, the Anglo-Persian Oil Company claimed £500,000 ($1,830,500) for the loss sustained from the damage done by Bakhtiaris) in blowing up her pipelines in February, 1915. Negotiations which took place in London and Tehran failed to resolve these questions, and in mid-1920, a financial adviser to the Persian Government,

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* In 1913, the British Admiralty (headed by Winston Churchill), decided to shift from coal to oil as fuel for the Royal Navy. Thus the Iranian oilfields became of special interest as a principal supplier of petroleum for the British Empire.

S. Armitage-Smith, was appointed by the Persians to settle all the questions in dispute with APOC. An agreement was reached on December 22nd, 1920.[20]

The Armitage-Smith agreement differed greatly from the original D'Arcy concession, and unfavourably for the host country. The Persian Government lost many important rights and interests, and the financial losses sustained were substantial. The cessation of royalty payments from the APOC owned British Tanker Company was a major loss, as were the agreements that the subsidiaries should not pay royalties on income earned from trading in non-Persian oil, and that the companies dealing with oil outside Persia should deduct large amounts of money before royalties were calculated. Also, the term subsidiary was redefined to include only those companies of which at least 50% was owned by APOC.[21] Apart from the above terms of the agreement, the Persians received a payment of £1 million in respect of all their claims.[22]

The 1933 Agreement

Work continued under the above concession until 1932, but it became increasingly difficult for the two parties to agree. The direct reason for the Iranian complaints was the sharp decrease in the amount paid to Iran as royalty by APOC. The decline was from £1,288,000 ($6,259,680) in 1930, to £307,000 ($1,492,020) in 1931. This was due to a cut in prices in the oil industry. The result was that the net profits of APOC fell from £3.8 million ($18,468,000) in 1930, to £2,400,000 ($11,664,000) in 1931. The dissatisfaction of Iran with APOC may have been increased by the agreement of Iraq with the Iraq Petroleum Company. The latter country in their negotiations secured a minimum of £400,000 ($1,944,000) per annum starting from 1931, although their oilfields were not producing for export.[23]

Other complaints were that the Company sold oil to its subsidiaries and the British Navy at lower prices, and that it charged as a cost of oil operations, expenditures incurred by investment abroad. Iran also demanded a share in the profits of companies formed by APCC, but operating outside Iran. The company, however, refused to pay an income tax imposed by Iran in 1930, on the grounds that they were exempt under the terms of their concession agreement. Due to the company's failure to meet the demands of the Iranian Government, the concession was cancelled by Iran on November 27th, 1932, but five months later, on April 29th, 1933, a new agreement was reached.[24]

The 1933 concession agreement between Anglo-Iranian Oil Company (AIOC)* and the Iranian Government was not with a new concessionaire, and its contents were more or less a revision of the D'Arcy concession of 1901. The new agreement provided for an increase in the amount paid to Iran. The basis of royalty was changed from 16% of net profits to 4/- sterling (gold) (84 cents) per ton, with a guaranteed minimum payment of £750,000 ($3,163,500) in any year. Additionally, 9d (15 cents) was to be paid in order to replace taxation, and if more than £670,000 ($2,826,060) was distributed to the shareholders in any one year, the equivalent of 20% of the difference between the Company's General Reserve on December 31st, 1932, and on the date of expiry or surrender of the concession. Royalties for the years 1931 and 1932 were to be recalculated on the new basis, and Iran was to receive £1,339,000 ($5,647,000) and £1,585,000 ($6,685,000) respectively for those years. An additional £1,000,000 ($4,218,000) was also to be paid by the company for the settlement of all or any outstanding claims.[25]

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* In 1935, Riza Shah changed the name of the country from Persia to Iran, and the Anglo-Persian Oil Company was renamed the Anglo-Iranian Oil Company.

Apart from the above factors, the company's concessionary rights were extended for a further 32 years, to the end of 1993. The concession was confined to the south-west of Iran, and the area was limited to half of the D'Arcy concession, and this was to be reduced once again to 100,000 sq. miles on December 31st, 1938.[29] (See Fig. 1B.)

Nationalisation of the Oil Industry and the Consortium Agreement

The 1933 agreement produced a temporary solution to the Iranian oil dispute. Tension was renewed, however, after the second World War, and the outcome was Iran's accusations against AIOC.

According to their agreement, AIOC was to pay to the Iranian Government 20% of any dividends issued to the shareholders over £671,250 ($2,831,331). In the years 1941-48, this 20% amounted to only ¼ of the royalty received from tonnage, although at that time, AIOC's profits were high. The government had no control over the amount of dividend issued, and therefore could do nothing to increase its share. AIOC's subsidiary companies' dividends were also beyond the control of the Persian Government, which claimed that the dividends issued by these companies were kept as low as possible, so as to reduce the amount paid out by AIOC, thus reducing considerably the Government's revenue, e.g. the British Tanker Company, which was completely owned by AIOC and had a capital of £4,000,000 ($16,120,000) reportedly made a net profit of £10,000,000 ($40,300,000) in 1948, but only paid £240,000 ($967,200) to AIOC, according to the Persian Government.

In 1947, the British Labour government put an upper limit of 30% on all dividend distribution, which reduced the Persian Government's revenue even further, and although the amount deficient would have been paid when the concession ended, they were more interested in immediate revenue. The Persian government also complained about the loss of revenue incurred because of the British government's increase in the taxes on company profits, which affected its share of AIOC's dividends.

On the face of it, AIOC's payment of £51,000,000 ($205,500,000) in taxes to Britain looks much more than its payment of £16,000,000 ($64,400,000) in royalties to Iran. However, the £51,000,000 covers taxes on all AIOC's subsidiaries operating outside Iran, whereas the £16,000,000 was directly linked to the quantity of oil produced in Iran. Nevertheless, the difference was very marked, and did not pass unnoticed.

Iran then accused AIOC of concealing from the Iranians the true amount of oil exported. The discrepancy between the 32 million tons declared by AIOC, and the 56 million tons reported to have been exported was 24 million tons. The Persian Prime Minister mentioned this in October, 1951, at the U.N. Security Council, but he received no reply from the British Delegation. However, the British Government's representative at the Council did state that the Iranians seemed to have little say in matters concerning themselves.[27]

In June, 1948, AIOC approached the Persian Government to discuss a method of compensating them for the loss of revenue due to the British Government's policy, and in July 1949, a supplemental agreement was put forward by AIOC.

The new agreement provided for an increase in royalty payments, from the 1933 rates of 4/- (56 cents) per ton to the 1949 rate of 6/- (84 cents),* and from 9d (10.5 cents) to 1/- (14 cents) per ton instead of the Iranian taxation. The terms of the supplemental agreement were considered by AIOC to be the most favourable for any oil-producing country in the Middle East, at that time.

* Between 1933 and 1949 the dollar was revalued from $4.218 per £1, to $2.80.

However, the offer was criticised by Dr. Mossadeq (who was the instigator of the Majlis's* rejection of the supplemental agreement) in that it was lower than an offer already made to Saudi Arabia by the Pacific Oil Corporation on February 20th, 1947, and that agreement was made with a non-oil-producing company. In October, 1950, the supplemental agreement was submitted to the Majlis by the Prime Minister, General Razmara, for ratification. A parliamentary commission, headed by Dr. Mossadeq, had been set up to make recommendations to the Majlis regarding the supplemental agreement in December, 1950, the commission reported against the supplemental agreement on the grounds that it did not adequately guarantee Iranian rights and interests. Accordingly the Majlis refused to ratify it.

The news of the 50-50 profit sharing agreement between Saudi-Arabia and ARAMCO in January 1951, led to an increase in the demand for nationalisation of oil in Iran. AIOC, in order to settle the dispute, announced its readiness, on February 10th, 1951, to negotiate a new agreement on the basis of 50-50 profit sharing, but this was kept secret by the Prime Minister (General Razmara) for a propitious moment.** The outcome of the disagreement was that on February 19th, 1951, a draft project for the nationalisation was submitted to the Majlis by Dr. Mossadeq. On April 30th, the Majlis voted on the nationalisation of the oil industry, and on May 1st, 1951, the law was promulgated by the Shah.[28]

Immediately after nationalisation, the National Iranian Oil Company (NIOC) came into being. NIOC was to take over the existing AIOC facilities; to restore the flow of oil products for internal consumption; to find ways and

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* The Majlis is the Iranian Parliament.

** General Razmara was assassinated shortly afterwards without revealing AIOC's offer.

means for the resumption of exports of Iranian crude oil and products; and to engage in all phases of oil operations.[29]

Unfortunately, the new company was not able to carry out the above tasks, due to financial difficulties and boycotting of Iranian oil throughout world markets. The result of the nationalisation of May 1st, 1951, was that production in Iran dropped sharply, the daily average production dropped from 664,300 barrels in 1950, to 349,600 in 1951, 27,600 in 1952, and 26,800 in 1953, as the dispute dragged on. Alternative oil resources in the Gulf region, of which those in Kuwait are a good example, were developed rapidly.[30]

On October 29th, 1954, after three years of deadlock, a settlement was reached between Iran on one hand, and the British and U.S. Governments, and eight major oil companies on the other. The new agreement was concluded between Iran and a group of oil companies including British Petroleum (formerly AIOC), formally known as Iranian Oil Participants, but generally called Consortium. The Consortium was initially composed of eight international oil companies, but was later joined by eight independent American oil companies.

The shareholders of Consortium are shown in the following table.

Table 1 The shareholders in Consortium

Nationality	Company	Percentage
British	British Petroleum	40
British-Dutch	Royal Dutch-Shell Group	14
French	Compagnie Francaise de Petroles	6
American	Standard Oil Co. (New Jersey)	7
	Standard Oil Co. of California	7
	Socony Mobil Oil Co.	7
	The Texas Co.	7
	Gulf Oil Corporation	7
	Iricon Agency Ltd.*	5

Source: George Lenczowski, Oil and State in the Middle East, Cornell University Press, Ithica, New York, 1960, p.10.

* Iricon Agency Ltd. is owned by nine American independent oil companies whose share of its 5% is in the following proportions: Richfield Oil =

In the course of trying to reach a settlement for the turnover of AIOC's fixed assets, and for the loss of 60% of her interest to other oil companies, it was calculated that the Anglo-Iranian Oil Company owed £51,000,000 ($142,800,000) to Iran and NIOC, but also that Iran and NIOC owed £76,000,000 ($212,800,000) to AIOC. This left a difference of £25,000,000 ($70,000,000) due to AIOC, which was to be paid in 10 equal, yearly installments of £2,500,000 ($7,000,000) beginning on the 1st January, 1957. (Article 1 of the Agreement.)[31]

Although the Consortium agreement did not differ fundamentally from the pattern of concession which had been set up elsewhere in the Gulf, three factors could be pointed out, i.e. Consortium operates on behalf of the Iranian government and not as a concessionaire, the government being the sole owner of its oil resources. The Consortium constitutes a multi-national group, whereas the previous concessionaire represented a single nation, i.e. Britain. The non-basic operations (health, medical aid, education, training, housing and welfare) were left as the responsibility of NIOC throughout the concession area. (The cost was to be refunded to NIOC by the operating companies.)[32]

Under this new agreement, consortium was granted rights of exploration, drilling, refining and transportation in a specified area of south-west Iran called the Agreement Area. (Fig.2.) The agreement was to run for 25 years and the companies had the right to extend it by three periods of five years each, these extensions being conditional upon reductions in the size of the Agreement Area which would have approximately halved the original area (100,000 sq. miles) by the commencement of the last extension. The agreement embodied .

= Corporation, 1.25%, American Independent Oil Co., 0.833%, and Standard Oil Company (Ohio), Getty Oil Co., Signal Oil & Gas Co., Hancock Oil Co., Tide Water Associated Oil Co., and San Jacinto Petroleum Corporation, 0.417% each.

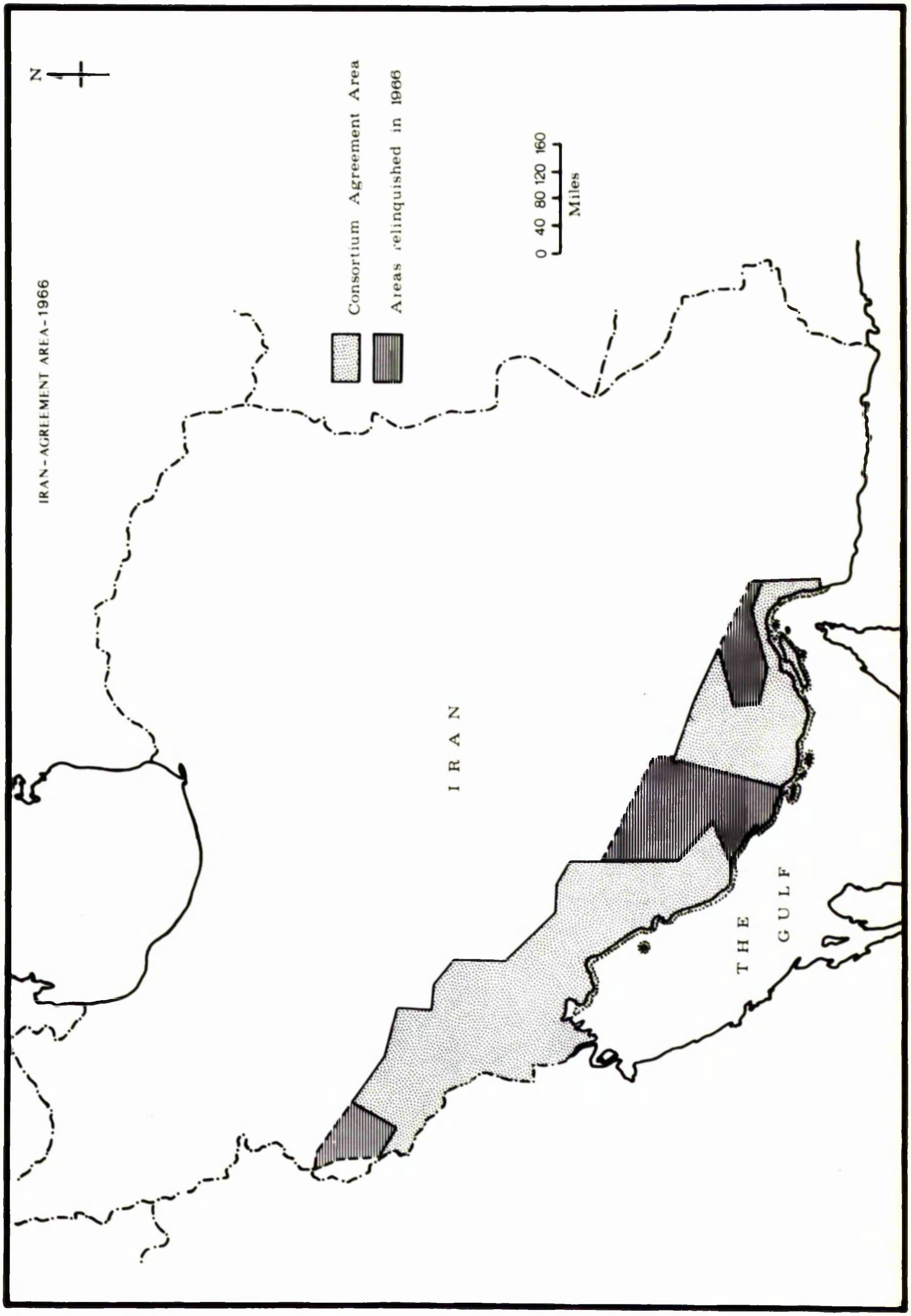

Fig. 2 - Consortium agreement, and areas relinquished in 1966.

the provision of 50-50 sharing of net profit, (which is further discussed under Saudi Arabia). According to this provision, each barrel of oil exported would have yielded the Iranian Government an income almost four times that received prior to nationalization. The agreement was to be operated on behalf of Consortium by two operating companies: The Iranian Oil Exploration and Producing Company, and the Iranian Oil Refining Company, jointly to be called the Iranian Oil Operating Companies.[33]

However, operations under the Consortium Agreement continued without any changes until December 1966, when a modification occurred with regard to areas under concession. According to the agreement, Consortium relinquished 25% of the area (65,000 sq. km.) in three places, the first being south-west Kirmanshah, the second starting from the Gulf coast, running northwards to a point north of Shiraz, and the third north of Bandar Abbas. The Agreement Area is now composed of two blocks, one containing the main oil fields in the south, and the other extending eastwards along the coast where exploitation is expected in future.[34] (Fig. 2.)

The provisions of the new agreement provided for Iran's oil income to be calculated on a new basis, and the result was that the country's income per barrel was increased. In 1954 the oil revenue from the Consortium area was £3,100,000 ($8,680,000), this mounted to £265,600,000 ($743,680,000) in 1967, which was an increase of £58,100,000 ($162,680,000) over 1966.[35]

Post 1957 Law Agreements

In order to speed up the development of the Iranian oil resources, on July 29th, 1957, a new law which opened the doors for additional foreign oil companies was approved by the Iranian government. This reversed the policy adopted by Iran in September 1944 (during the Second World War) which forbade the granting of any more concessions to foreign companies.[36] Quite apart from association with Consortium and its own operations, the 1957 Law made NIOC responsible for the development of oil resources in all parts of the country outside the Agreement Area and the Continental Shelf.

The company was also authorised to grant concessions to foreign companies on the basis of partnership. Under this law, terms of agreement are more harsh on foreign partners, payments are fixed at a principle of 75-25 per cent sharing of net profit in favour of Iran, including a payment of a sum as a bonus, heavier drilling obligations and compulsory surrender of territory.[37]

It appears that the oil companies were more or less undeterred by the restrictions provided by the new Law. NIOC signed an agreement with Agip Mineraria, a state-owned Italian firm, on August 12th, 1957, (14 days after the passing of the Law). This was followed by a series of agreements. All the agreements granted by NIOC can be put into two categories: (a) joint venture agreements, and (b) contracting agreements. The main provisions of the first type are as follows:

1. The profits will be divided on the basis of 75-25 (including income tax).

2. Income tax payable equal to 50% of the second party's share of the profits calculated on the posted price without any discount.

3. All the exploitation expenditures should be undertaken by the foreign partner, in the event of commercial discoveries, NIOC is liable to a payment of 50% of the amount spent, otherwise nothing.

Under the above provisions, joint-venture agreements with NIOC were granted to Agip Mineraria (thereafter known as SIRIP), on August 12th, 1957; Pan American Petroleum Corporation (subsidiary of Standard Oil Co. of Indiana, later called IPAC) on May 31st, 1958; and Sapphire Petroleum Ltd. (a Canadian corporation - IRCAN) on June 22nd, 1958. The last agreement came to an end in 1959 because of a dispute between NIOC and IRCAN.[38]

During 1965, NIOC granted 6 separate concessions. (See Fig. 3.) The bidders were composed of 5 groups and one individual company totalling 25 companies in all - 12 American, 7 German, 3 French, 1 Anglo-Dutch, 1 Italian, and 1 Indian. As a result, 6 new companies were set up in equal partnership with NIOC, their agreements embodying the usual 75-25% profit sharing agreements. The companies referred to are as follows:

Table 2 The companies which signed agreements with NIOC during 1965

Parties to the agreement	Name of company	Agreement area sq. kms.
NIOC-Shell Co.	Dashtestan Offshore Petroleum Co (DOPCO)	6,036
NIOC-Tidewater Group	Iranian Offshore Petroleum Co. (IROPCO)	2,250
NIOC-Agip, Phillips Hydro Carbon Private (Indiana) Ltd.	Iranian Marine International Oil Co. (IMINOCO)	7,960
NIOC-French Group	Farsi Petroleum Co. (FPC)	5,759
NIOC-Atlantic Group	Lavan Petroleum Co. (LAPCO)	8,000
NIOC-German Group	Persian Gulf Petroleum Co. (PEGUPCO)	5,150

Source: NIOC Publication, The Aims and Achievements of the Iranian Oil Industry, pp.1-2.

The above mentioned agreements were identical in their main provisions and all paid various types of bonus except for SIRIP.

The Iranians were pioneering in the Middle East when they started the joint structure agreements, and their example was emulated in countries like Egypt, Tunisia and others.

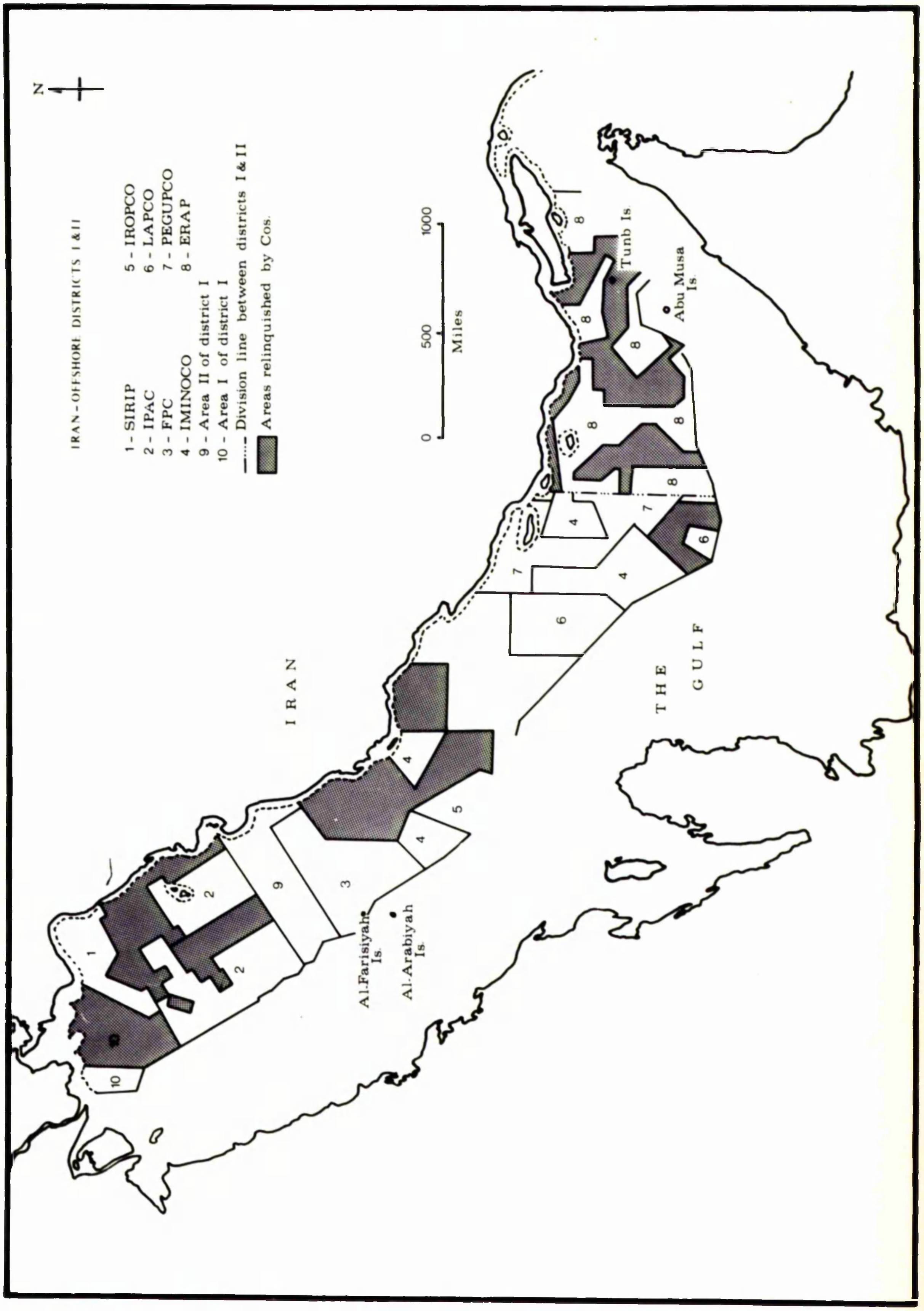

Fig. 3 - Offshore agreements.

In December, 1966, the Iranians concluded a revolutionary agreement with a French group (ERAP). This was completely different in nature from those oil agreements previously made.

According to this new agreement the French Group acts as a special contractor on behalf of NIOC to carry out all the activities relating to geological surveys, exploration, drilling etc. The contractor provides the capital for the implementation of these activities. In the case of oil discovery in commercial quantities, expenditure will be regarded as a loan to NIOC without any interest, otherwise it is regarded as the contractor's loss.

In March, 1969, another oil exploration contract was concluded between NIOC and AREPI (Association de Recherche et d'Exploitation d'Iran). The provisions of the contract were similar to those given to ERAP in 1966.

In concluding this section it may be remarked that the above history shows that fundamental changes have occurred over the years in the nature and context of oil agreements, and that the efforts which have been made by the producing countries to obtain maximum benefit from their natural resources have been rewarded, albeit gradually.

Also, it should be noted that Iran is dependent upon its oil revenues for unique reasons. Whereas as far as domestic products are concerned, oil represents less than a quarter of the national income, foreign exchange accrued from oil companies' activities represents a very high proportion of the foreign exchange income. Naturally it is from this foreign exchange income that Iran finances its economic development programme.

b. Oil Concessions in Saudi Arabia, Kuwait, and the Neutral Zone

While Iran on one side of the Gulf was becoming prosperous from its oil, the Arabian side was left far behind, and no real consideration was given to it in the pre-1920 period with regard to the possibility of exploiting its oil resources. This was due mainly to Turkish mal-administration and consequent political instability and lack of security. The Gulf at this time was under British control. Britain entered the Gulf for the first time in the 17th century, but its control over the Gulf began in 1820, when it signed a peace treaty with all the shaikhdoms of the Western Coast, where piracy was a constant source of turmoil and trouble. In the Gulf, the threat of the Baghdad Railway* with all the possible disturbances that it could bring to the British position in the Gulf, led Britain to arrange with the ruling Shaikhs of the Gulf Principalities (these were British Protectorates) that all exploitation of oil in the territories should be undertaken by British interests. One such agreement was reached in 1899 with the ruler of Kuwait whom the Turks claimed as a subject, though admitting his de facto independence. This agreement received confirmation on October 27th, 1913, when the Shaikh (Mubarak) undertook that no oil concession would be granted without the consent of Britain. In May, 1914, a similar agreement was concluded with the ruler of Bahrain. Then the Trucial Coast Principalities and Oman followed suit in signing similar agreements with Britain.[39]

The al-Hasa province of Arabia at this time was under the control of Abdul Aziz Ibn Saud, the ruler of Najd. In 1915, a treaty was signed between Ibn Saud and the British, the general terms of the Treaty being that Ibn Saud

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* On the 5th March, 1903, Germany obtained a concession from the Ottoman Sultan to build a railway line connecting the Gulf with Berlin, passing through Basra, Baghdad, and Turkey. This project was opposed by the British on the grounds that Britain had vital oil interests in Iran, and that her imperial communication with India would be threatened should this line be controlled by another great power.

would not grant any oil concessions to foreign subjects unless they were appointed by Britain.[40] (This came to an end in 1927.) Clearly such an agreement excluded foreign oil companies from securing oil rights in the area. However, in spite of their privileged position, British oil companies did not show great interest in the area. One factor which may have discouraged them was the lack of political stability at the time. (Abdul Aziz Ibn Saud took over the al-Hasa province on the Gulf from the Turks in 1913; Jabal Shammar, the north east part of Saudi Arabia in 1921 when he conquered Ibn Rashid; and Hijaz on the west of Saudi Arabia from its Sharifian ruler, King Hussein, in 1925.), The continual political conflict, coupled with the possibility that they might not find oil, were major factors which made the companies wary of investing in the area. Britain began to show real interest in the oil of the area in 1920, when Major Holmes began to take interest in Arabian oil, and more particularly in al-Hasa, the Kuwait/Saudi Neutral Zone, Kuwait and Bahrain. Major Holmes was the representative of the Eastern and General Syndicate, which was formed in London in 1920, and although little attention was given to it at the time, it was to play an important role later on. In May, 1923, Holmes obtained oil exploitation rights in al-Hasa province from Ibn Saud, and the Syndicate started drilling under the supervision of a Swiss geologist. Unfortunately, drilling revealed no oil-bearing structure, and since the Syndicate could not meet the costs of further development itself, and failed to interest any major oil companies, the rights to al-Hasa lapsed in 1927.*[41] After obtaining the rights over al-Hasa, Holmes' next move was to look at Kuwait, the Kuwait/Saudi Neutral Zone and Bahrain. He was able to secure oil rights over the Neutral Zone from Kuwait and Saudi Arabia in 1924, over Bahrain in 1925,[42] and he also secured oil

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* Longrigg, Oil in the Middle East, mentions that the rights lapsed in 1927 after two renewals.

rights for the Kuwait mainland and its islands in 1926. In the event, since the Syndicate again could not raise the capital itself for the exploitation of these concessions in the Neutral Zone and Kuwait, the Neutral Zone rights lapsed in November, 1927, though the Syndicate still had in its possession the Kuwaiti rights.[43]

Saudi Arabia

In 1930, the world was suffering from an economic depression, which adversely affected Saudi Arabia. The country was then almost entirely dependent on the pilgrimage for its revenue. The anticipated income from pilgrimage visitation for 1931 was expected to fall below average, due to the sharp fall in the prices of agricultural products in India and the Far East, which made it more or less impossible for members of the agricultural communities of these parts to visit Mecca. Although the political situation in Saudi Arabia in 1931 was reasonably stable, and the King's authority was unquestioned, it cannot be doubted that stability and security could not have lasted long without the government being able to rely on a steady source of income, rather than having to depend on an unstable one. At that time, Ibn Saud's government was in a great deal of debt, and could not pay either its creditors or disburse subsidies to local tribal groups. To illustrate to what extent the government needed money, Philby, in his book "Arabian Oil Venture", states that "on one such occasion, at Taif, (1930) the King blurted out: 'Philby! If anyone would offer me a million pounds now (in gold), I would give him all the concession he wants'." This gives a clear picture of how badly the country was in need of money. The situation became worse when no-one approached the King to secure an oil concession, because of the understanding that the prospect of oil discovery in the Gulf region had been virtually written off with the collapse of the Syndicate's concession.[44]

However, in 1933, while the country was in such a state, the Standard Oil Company of California, encouraged by the discovery of oil in Bahrain in 1932, applied to the Saudi Government for an oil concession in al-Hasa province.

Apart from Standard Oil Company, only Iraq Petroleum Company (IPC) was interested in obtaining the al-Hasa concession. But since the latter could not meet the terms asked by the Saudi government, the concession was granted to the Standard Oil Company of California, and it was signed under the name of California Arabian Oil Company.*

The concession covered an area of about 360,000 sq. miles, as well as preferential rights** to additional concessions which could be obtained by meeting the terms of any offer made to the government, and which was to run for 66 years. The Company agreed to advance loans (in gold) to the government, repayable from the future royalties which were fixed at 4s gold (84 cents) per ton. Thus an amount of £30,000 ($126,540) was paid by the company as an initial loan, plus an annual payment of £5,000 ($21,090) and if the agreement lasted for more than 18 months, a second loan of £20,000 ($84,360) would be paid. The government was also to receive a loan of £50,000 ($210,900) upon the discovery of oil in commercial quantities, and a similar amount one year later. According to the agreement, the company was to construct a refinery and to supply the government

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* S. Longrigg, the IPC negotiator for the concession, in his book Oil in the Middle East, with reference to the loss of the concession illustrates how the "IPC directors were slow and cautious in their offers and would speak of rupees when gold was demanded" and their negotiator was "handicapped and could do little". p.107.

Philby, who played an important role in this agreement, mentions in his book Arabian Oil Venture, how in his meeting with Longrigg, he was told that "IPC did not need any more oil, as they already had more in prospect that they knew what to do with". At the same time, IPC were vitally interested in keeping out all competitors. p.106.

** The preferential area was approximately 177,000 sq. miles, located in the central and western parts of Najd.

Typist's Error:

Two page numbers have been omitted in error. Page 95 follows directly from page 92.

free of charge with 200,000 gallons of gasoline and 100,000 of kerosene per annum.[45] Comparatively, Iran was leading all its neighbouring countries with respect to bonuses, rentals, tax commutation, free delivery of oil and other benefits, as it was sharing in the overall profits of APOC, and these profits were derived from Persian concessions and other operations.

Although both Saudi Arabia and Persia received a royalty of 4s gold (84 cents) per ton, the Saudis were, in fact, better off, as they received a higher valuation of the shilling gold, since this was made before the devaluation of sterling in 1933, and Persia's valuation was made afterwards. The difference was 35 shillings ($6.1) - from 85 shillings ($14.8) per fine ounce of gold, to 120 shillings ($21.0).[46]

The Standard Oil Company of California, the holder of the Bahrain and Saudi Arabian concessions, faced difficulties in marketing the Bahrain output. In order to tackle this problem and take account of the production that might develop in Saudi Arabia, the company concluded an agreement with Texas Oil Company, in December, 1936, whereby the Texas Company received a 50% interest in the Bahrain and Saudi Arabian concessions. In return the Standard Oil Company obtained a 50% interest in Texas Oil Company's Far Eastern marketing facilities and also a sum of $3 million in cash, and $18 million in deferred payments from future production in Saudi Arabia.[47] In 1934, the California Arabian Oil Company, under its agreement with Saudi Arabia, began drilling and on October 16th, 1938, oil was discovered in commercial quantities.

On May 31st, 1939, a supplemental agreement was concluded between the government and the California Arabian Oil Company, whereby additional areas in the north and south were added to the original area, including the Saudi Arabian half interest in the two Neutral Zones on its borders with Kuwait and Iraq. Following this agreement the exclusive concession area reached approximately 496,000 sq. miles.[48] (Fig. 4.) Comparatively, this area was the largest covered by any concession in the Middle East at the time. The Iraqi concession area was about 164,000 sq. miles, the Iranian 100,000 sq. miles, and the Kuwaiti about 6,000 sq. miles.

In return for extensions and modifications made to the original concession agreement, the Company agreed to make several payments in gold. £140,000 ($564,200) as a bonus and an annual rental of £20,000 ($80,600) until the discovery of oil in the additional areas was due to the government. The Company was also to pay to the government a sum of £100,000 ($403,000), as a bonus, or on early relinquishment of those areas. No changes were made to the royalty payment, but the duration of the concession was extended to 60 years from 1939.[49]

In the early 1940's, the Company carried out significant exploration and development work, which proved the existence of vast oil resources in areas under concession. Meanwhile the Company had plans for the construction of a large diameter crude oil pipeline to the Mediterranean. There was no doubt that the Arabian American Oil Company (ARAMCO)* was capable of supplying oil in quantities far beyond its pre-war production. Once again the Company was faced with the problem of finding outlets for its oil. Thereafter, it started negotiations with other American oil companies that had marketing facilities as well as capital, i.e. Standard Oil Co. (New Jersey), and Socony Vacuum (now Socony Mobil). In March, 1947, the Standard Oil Co. (New Jersey) acquired 30% and Socony 10% of ARAMCO's shares. The remaining 60% was held in equal parts by the two original owners, Standard of California, and Texas Oil Company.[50] In return for the sale of 40% of ARAMCO's shares,

* On 31st January, 1944, the name of the California Arabian Oil Company was changed to Arabian American Oil Company (ARAMCO).

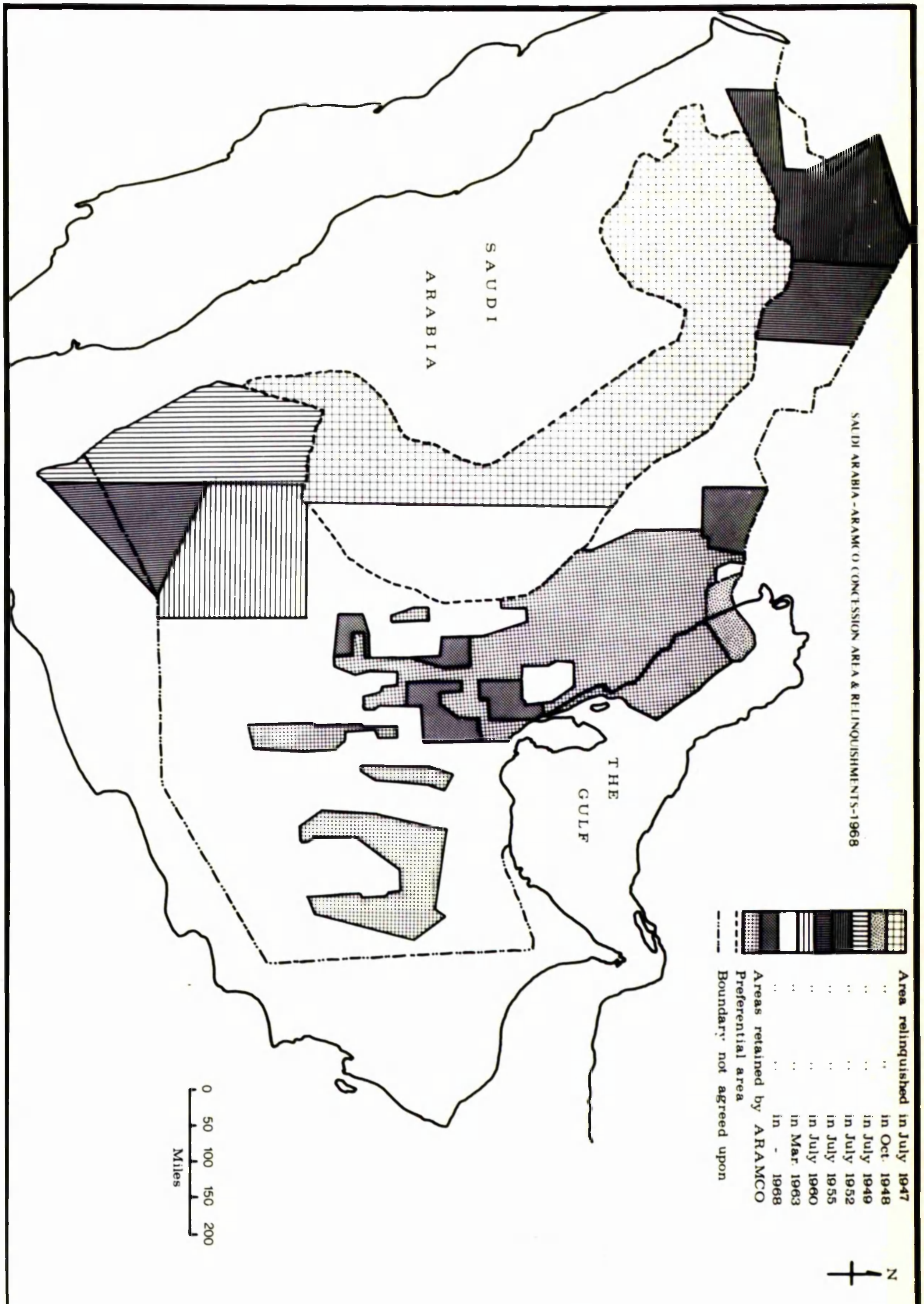

Fig. 4 - ARAMCO areas, including the preferential areas, and areas relinquished since 1947.

the California and Texas were to receive from Standard (New Jersey) and Socony a sum of $76.5 million and $25.5 million respectively. In addition, the two companies agreed not to receive dividends until the full payment of the specified amounts.[51] Consequently, production in Saudi Arabia increased from an average of 246,000 barrels per day in 1947, to 390,000 in 1948, and to 477,000 in 1949.

For oil companies, exemption from taxes was a usual term of concession agreements, although a royalty of 4s gold (84 cents) per ton of oil produced was payable. After World War II, production increased greatly, and governments started pressing for a larger share of the profits from crude oil.

On December 30th, 1950, the Saudi Government and ARAMCO agreed to revise the 1939 agreement so as to provide for 50-50 profit sharing after U.S. taxes. Then, on October 2nd, 1951, a new formula was reached by which the government was to receive its 50% of the profit before the U.S. taxes.[52] The 50% was to be paid to the King as a form of income tax.* This started other countries to ask for the same terms, which they obtained, causing oil revenues to rise rapidly. The rise was not entirely due to the tax, however, as the 50-50 arrangements necessitated the fixing of a price for crude oil, which was higher than that used previously. At first, companies were allowed large marketing allowances by the governments of the producing countries, but this was eventually stopped.[53]

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* This tax actually cost ARAMCO nothing, as the amount paid was deductable from the Company's liability under U.S. income tax laws, which meant that the U.S. Treasury was, in fact, paying the tax. This was probably because the U.S. government was very interested in consolidating the positions of the U.S. oil companies in the Middle East. Also, in 1948, royalty payments in terms of dollars had increased considerably when Iraq and Saudi Arabia insisted that their payments should be based on the free market price of gold in the Middle East, and not on the lower price fixed by the British and U.S. governments.

ARAMCO, since 1939, has relinquished 391,000 sq. miles from its concession as it then existed. Thus, in 1968, 105,000 sq. miles covering 5 sections was left from the total area. Apart from that, in 1963, it relinquished all of its rights over the preferential area. According to the 1963 agreement between the government and the Company, there are to be further relinquishments of undeveloped areas at 5 year intervals, so that the total area will be 20,000 sq. miles by 1993.[54] (See Figs. 4, 5, and 6.)

Recently, Saudi Arabia has signed two contract-type concessions with AUXIRAP and AGIP (ENI), but to date, information about these is not available.

Kuwait

As previously mentioned, the Eastern and General Syndicate's oil rights in al-Hasa and the Kuwait/Saudi Neutral Zone lapsed in November, 1927, due to the Syndicate's financial difficulties, but it still retained the Kuwaiti rights. Because of these financial difficulties, the Syndicate sold its rights in Kuwait to Gulf's subsidiary, Eastern Gulf Oil Company of U.S.A., in November 1927, after it had failed to interest the British Oil Companies.*

In 1931, negotiations between Kuwait and the Gulf Company (acting through the Syndicate) were at the point of success, when the British Government intervened, and opposed any such agreement on the grounds that it contravened the 1899 treaty** which stated that only British interests were to be granted oil concessions.[55]

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* "In the summer of 1933, Gulf paid Eastern and General Syndicate $175,000 to relinquish any rights it might have with regard to Kuwaiti Oil." (E.H. Brown, The Saudi Arabia/Kuwait Neutral Zone, Beirut, 1963. p.92.)

** The following was accepted by the Ruler of Kuwait: "He further binds himself, his heirs and successors not to cede, lease, mortgage or give for occupation or for any other purposes any portion of his territory to the Government or subjects of any other Power without the previous consent of Her Majesty's Government for these purposes." (Mikdashi, pp.80-81.)

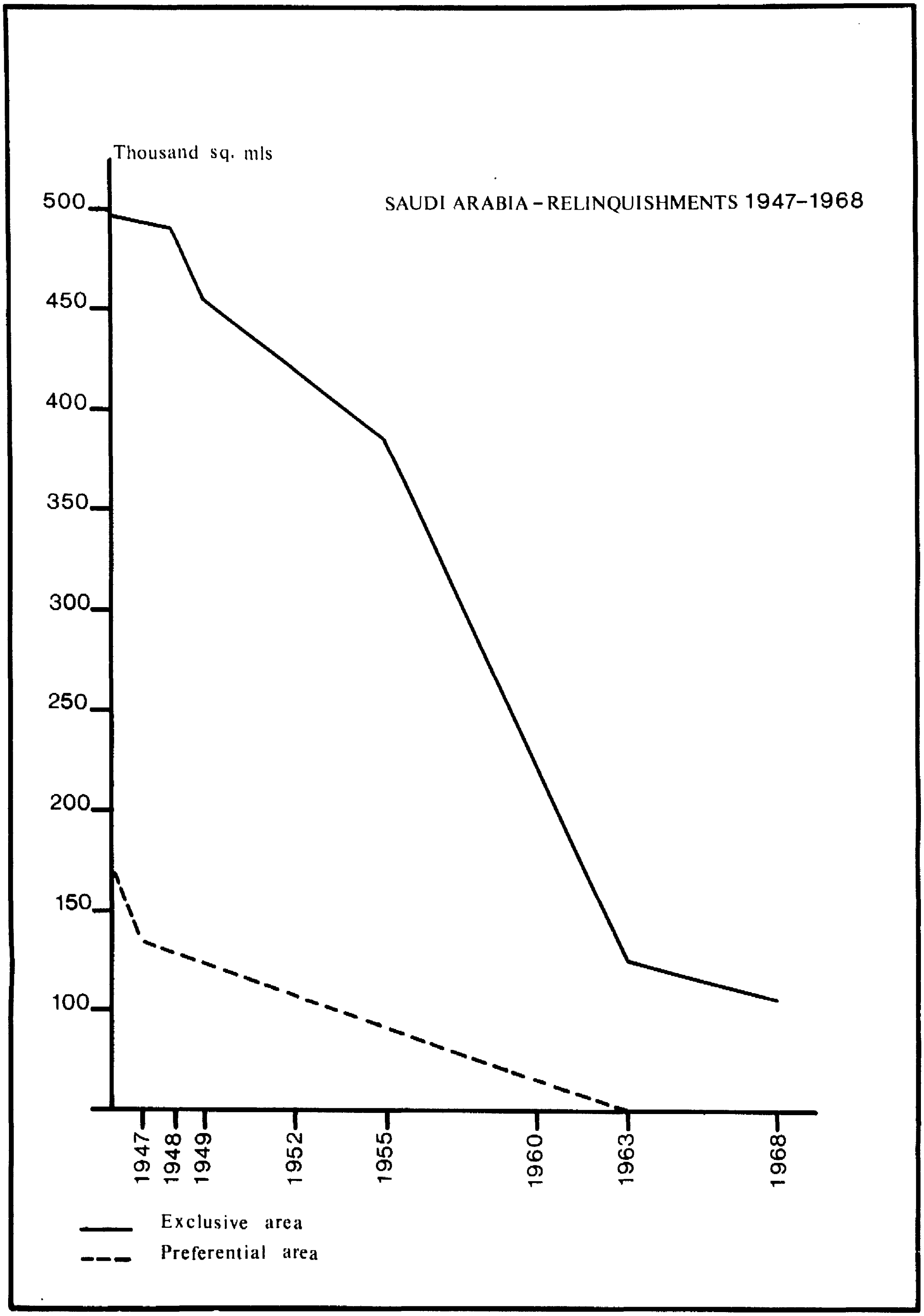

Fig. 5 - Acreage relinquished by ARAMCO since 1947.

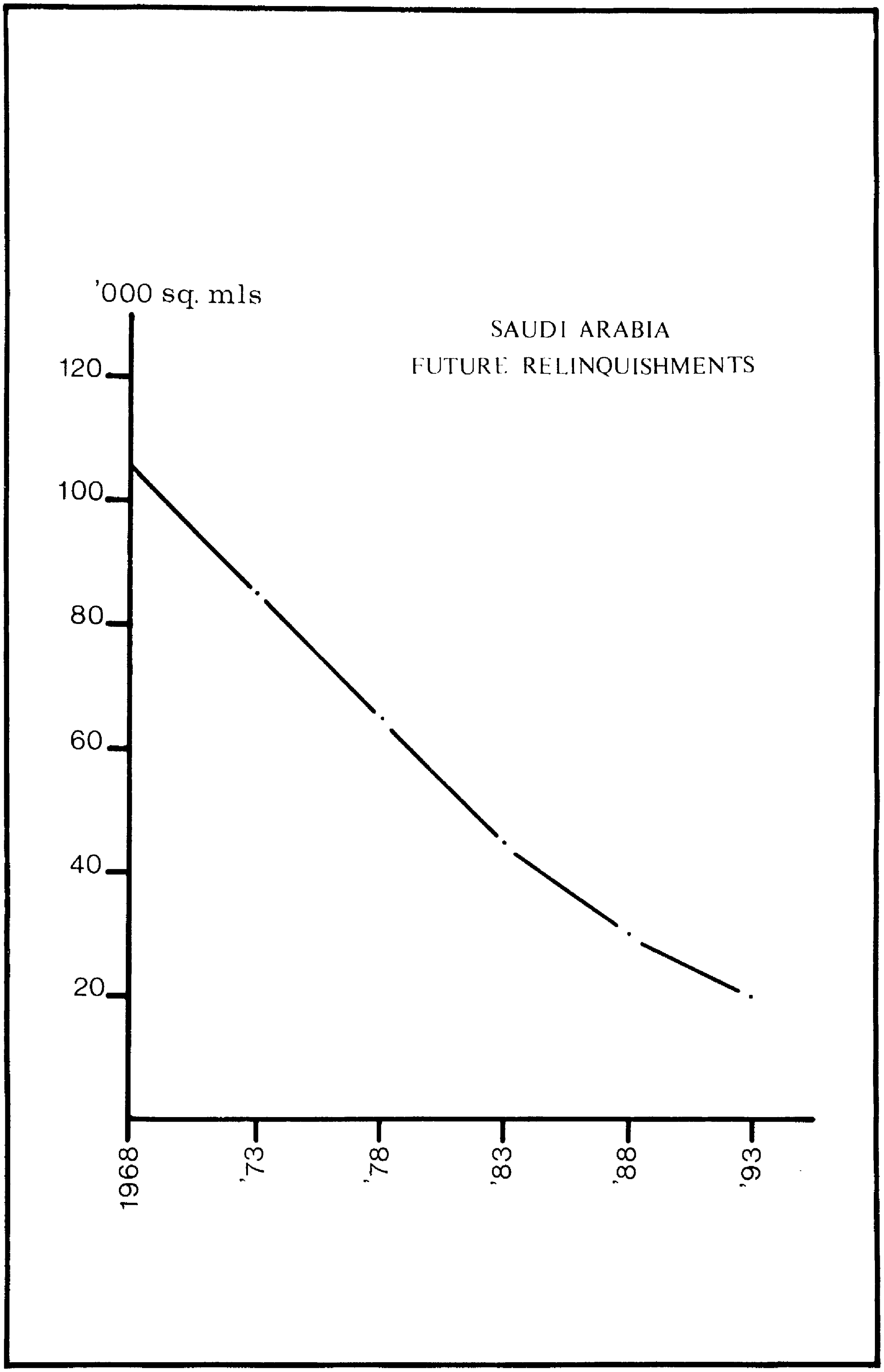
'000 sq. mls
SAUDI ARABIA
FUTURE RELINQUISHMENTS
120
100
80
60
40
20
1968
'73
'78
'83
'88
'93

Fig. 6

In 1932, the Anglo-Iranian (which changed its name in December, 1954, to British Petroleum - B.P.) showed interest in obtaining oil concessions in Kuwait, and in fact was permitted to survey the territory and even to drill two shallow wells.[56] This action by Anglo-Iranian clearly angered Gulf Oil, who in turn protested to the United States Department of State, who sent a Note to the British Foreign Office. This was delivered by the American Ambassador in London, Andre Mellon (who, incidentally, owned a large number of shares in Gulf), and it required equal treatment of American firms under the "open-door" policy.*[57] The reason why Gulf and Anglo-Iranian were so determined not to lose Kuwait was clearly that substantial oil deposits were indicated, and this belief was strengthened by the discovery of oil in Bahrain in 1932.

After a period of about two years of intense negotiations between the two companies, (Anglo-Iranian and Gulf Corporation), on December 14th, 1933, the two parties agreed that they were to apply jointly for the use of Eastern and General Syndicate's rights in Kuwait. After this, in February, 1934, the Kuwait Oil Co. (KOC) was formed, administrated equally by the two partners and acting as their agent. Opinion differs as to the amount of capital it started with, the range being from £100,000 to £200,000 ($504,100 to $1,003,200).**[58]

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* The "open-door" policy consisted of three main provisions, the first being that in all mandated territories, nationals of all nations should receive equal treatment in law; the second was that in any such territory, no economic concession was to be so big as to exclude all others; and the third was that no concession regarding any commodity should be granted to one country only.

** Zuhayr Mikdashi in his book Middle Eastern Oil Concessions (1901-1965), mentions that a sum of £50,000 was paid by each of the partners (p.82), and Charles Issawi and Mohammed Yeganeh in The Economics of Middle Eastern Oil, mention £100,000 paid by each of the parties (p.35).

The two parties also agreed that "neither party was to dispose of its interest therein without the consent of the other, and each would abstain from action damaging the other's marketing position."[59] Then, on December 23rd, 1934, the concession was granted to KOC. The terms of the concession were generous, and covered the whole area of Kuwait, about 6,000 sq. miles, and its territorial waters as far as 3 nautical miles offshore. As mentioned previously, this was the smallest area covered by a concession in comparison with neighbouring countries (Saudi Arabia, Iran, and Iraq). (Fig.7.) The 75 year duration was the same as that of Iraq and longer than the 60 years of Saudi Arabia and Iran. The Kuwait Oil Company was liable for a bonus payment of rupees (Rs.) 470,000 (£35,625 or $179,585) paid within a period of one month counted from the date that the concession was signed; a royalty of Rs. 3 (4s.6d. or $1.10) per ton; and an annual minimum of 250,000 rupees (£18,750 or $80,525).[60] This payment may be compared unfavourably with those agreed by Iran and Iraq. Under her agreement of 1933, Iran was to receive not less than £750,000 gold ($3,163,500) per annum, and Iraq in 1931 agreed to £400,000 ($1,944,000). Also KOC agreed to pay 4 annas (4½d or 9.3 cents) per ton as a tax exemption fee, and dead rent of Rs. 95,000 (about £7,125 or $35,917).[61]

Generally, it may be noted that although KOC's concession was granted at a later date than the others, i.e. when the Gulf region was already known to be a likely oil bearing territory, the financial terms obtained by Kuwait were less favourable than those of the neighbouring countries. Payments to Kuwait were made in Indian rupees (the currency of Kuwait) and were not backed by gold, while Iran, Saudi Arabia, and Iraq received theirs in gold. In the period prior to 1951, royalty payments of 10 cents per barrel

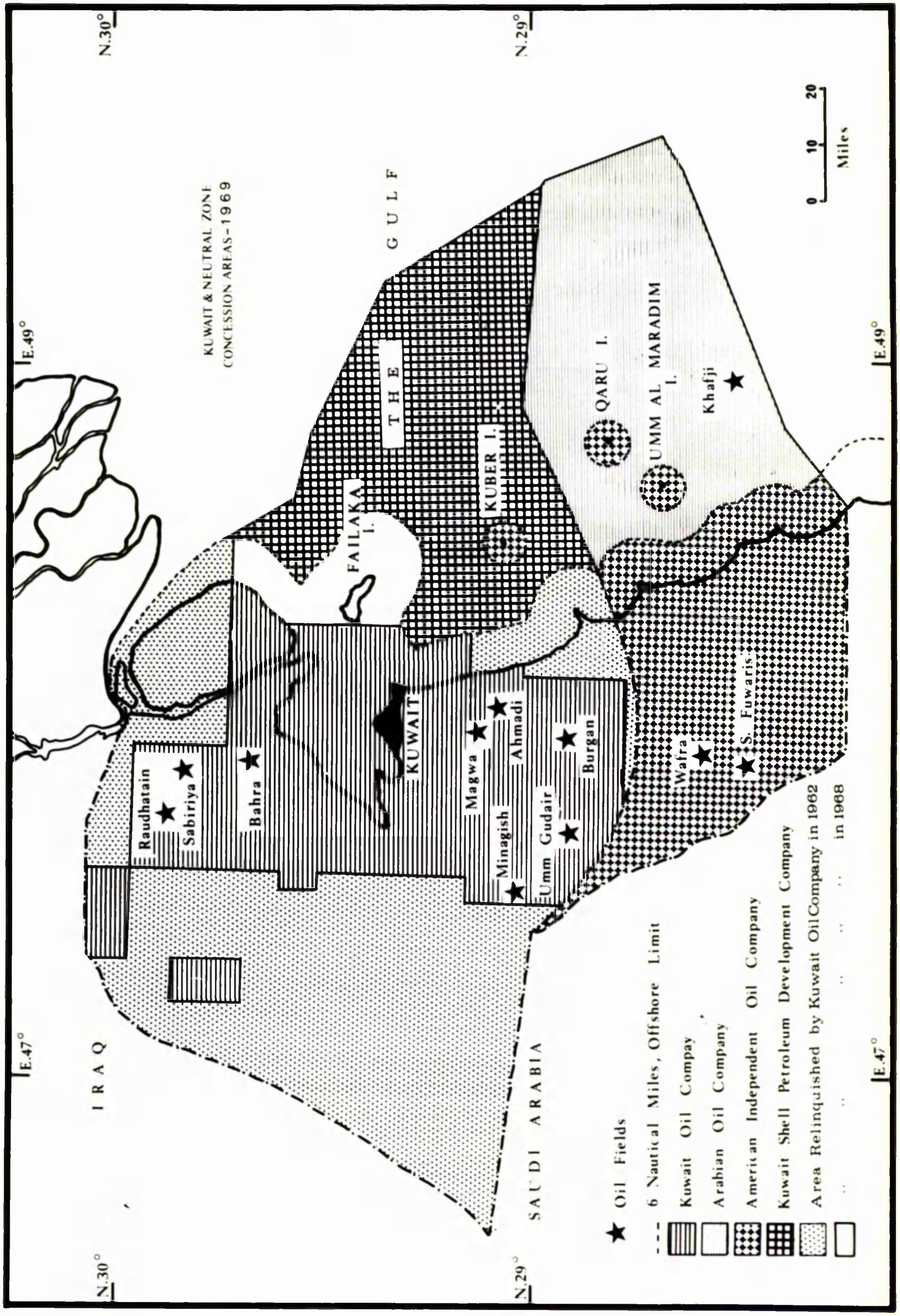
KUWAIT & NEUTRAL ZONE
CONCESSION AREAS - 1969
THE GULF
IRAQ
SAUDI ARABIA
KUWAIT
FAILAKA I.
KUBER I.
QARU I.
UMM AL MARADIM I.
Khafji
Raudhatain
Sabiriya
Bahra
Magwa
Ahmadi
Minagish
Umm Gudair
Burgan
Wafra
S. Fuwaris
N.30°
N.29°
E.47°
E.49°
0 10 20
Miles
Oil Fields
6 Nautical Miles, Offshore Limit
Kuwait Oil Compay
Arabian Oil Company
American Independent Oil Company
Kuwait Shell Petroleum Development Company
Area Relinquished by Kuwait OilCompany in 1962
" " " " in 1968

Fig. 7

to Kuwait by the concessionaires were less than those given to neighbouring countries. When payments in Iran, Saudi Arabia, and Iraq amounted to 22 cents per barrel, Kuwait was receiving the equivalent of 13 cents per barrel. This was reduced to 9 cents in 1949, due to the devaluation of the Indian rupee.[62]

Following the introduction of profit-sharing agreements in Saudi Arabia and Iraq, in 1951, Kuwait, in order to increase her income from oil, requested Kuwait Oil Company to modify the terms of the 1934 agreement, Kuwait asked for 50% of KOC's actual net profit as payment of income tax in the proposed new agreement and also asked that the Company relinquish the islands which had hitherto been included in the concession area. In return for their acceptance of the Kuwait Government's demand, the Kuwait Oil Company was to have the period of its concession extended by a further 17 years, and also an increase was to be made in the offshore area of Kuwait and the islands located in the concession, from 3 to 6 nautical miles.[63] (See Fig. 7)

On May 8th, 1962, an agreement was concluded between the government and KOC, whereby the latter relinquished an area of about 9,262 sq. kms., mostly in the west of Kuwait, and equivalent to roughly 50% of the original concession area. In respect of the above agreement, a further acreage of 1,000 sq. kms, from the offshore areas of Failaka and Bubiyan Islands were relinquished in 1968.*[64]

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* There were many exploratory attempts by the Kuwait Oil Company, in those areas which were relinquished, and the company was not successful in finding oil in those areas in commercial quantities.

Kuwait Shell Development Oil Company:

When oil was discovered in commercial quantities by Arabian Oil Co. (AOC), in 1961, the sea-bed of the Gulf became more attractive to the oil companies as a potentially oil-bearing region. This became more obvious when Iran signed agreements with various foreign oil companies for the purpose of exploring the Iranian offshore areas.

In order to fully utilise its resources, Kuwait invited bids in 1960, from oil companies for an oil concession over its offshore.* The Shell International bid was chosen by Kuwait from other bids. The motive behind this, as explained by a Kuwaiti Government Official, was that Shell "(i) has as great an interest in maintaining a high posted price for crude as Kuwait does, (ii) is large enough to be able to move our oil into its own established markets without having to resort to price cuts, and (iii) because of its strong marketing position in the Eastern Hemisphere, would be in the best position to help our newly-established Kuwait National Petroleum Company get started in overseas refining and marketing."[65] On January 15th, 1961, Kuwait granted exploration and production rights over an area of approximately 1,500 sq. miles to the Royal Dutch/Shell Group. (See Fig. 7.) The agreement was to run for 45 years. A new company, the Kuwait Shell Petroleum Company, was to be established to handle all the matters connected with the undertaking. Shell was to pay a rental for the area of £1,000,000 ($2,800,000) for each of the first two years, and £2,000,000 ($5,600,000) a year after that, until regular exports began. The bonus payments would be £7,000,000 ($19,600,000) on signature,

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* In February, 1956, the Kuwaiti Government had done likewise, and a number of companies were known to have been interested, but after the Suez crisis, no attempts were made to obtain a concession in the area. (Middle East Economic Survey No.20, March 25th, 1960).

and a further £7,000,000 at the end of the fourth year or when production reached 100,000 barrels per day, which ever was sooner. Bonuses totalling a further £16,000,000 ($44,800,000) were to be paid in four equal installments when production rates reached 300,000, 400,000, and 500,000 barrels per day respectively. The agreement was signed on the basis of 50-50 with an option of 20% for the government to join as a partner in the venture upon the discovery of oil in commercial quantities.[66]

Unfortunately, in 1964, the Company, after a period of three years of exploration activities, stopped its operations because of border problems between Kuwait on the one hand, and Iran, Saudi Arabia, and Iraq on the other. (See before: Boundary Disputes in the Higher Gulf). The Company may resume its activities if an agreement is reached between the four dissenting nations.

The Kuwait/Saudi Neutral Zone

As mentioned previously, in the Oqair Agreement of December 1922, between Kuwait and Saudi Arabia, a Neutral Zone of about 2,000 sq. miles, located between Kuwait and the province of al-Hasa in Saudi Arabia was left undetermined. The Zone was left to be controlled on the basis of equal rights by Kuwait and Saudi Arabia.* Oil interest in the Zone dates from 1924, when Major Holmes, representing the Syndicate of London, obtained oil rights from Saudi Arabia and Kuwait. Since the Syndicate could not itself bear the cost of development and failed to interest any other major companies, the rights lapsed in 1927. The Zone remained without oil concessions from then until 1939 when ARAMCO acquired oil rights for the Saudi's half share of the Zone.

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* For more details see Land Boundaries in Chapter I.

In order to develop its share of the Zone, in 1946, Kuwait invited bids for concessions by competitive auction. On July 25th, 1947, in Delaware, a group of American investors who up to then had no Middle Eastern investments, formed the American Independent Oil Company, or by abbreviation, "Aminoil". The total shares of the Company were one million, priced at $1.00 each.[67] Aminoil is composed of several companies as shown in the table below.

Table 3 Shareholders in American Independent Oil Company

Companies	%age
Phillips Petroleum Co.	37.30
Signal Oil & Gas Co.	33.54
Ashland Oil and Refining Co.	14.13
James S. Abercrombie	7.06
Sunray Mid-Continent Oil Co.	2.95
Lario Oil & Gas Co.	1.77
Globe Oil and Refining Co.	1.77
Pauley Petroleum	1.48

Source: General Oil Affairs Department, Ministry of Finance & Industry, The Oil of Kuwait (Facts and Figures), Kuwait, September, 1965, p.37.

On June 28th, 1948, Aminoil's bid was successful, and a 60 year concession to explore for, produce, and utilize oil over Kuwait's onshore half-rights of the Zone was granted. (Fig. 7.)

The Government of Kuwait was to receive a royalty of $2.50 (about £1) per ton, (33 cents a barrel), compared with $1.1 (4s.6d) paid by KOC. This payment was by far the highest in the Middle East, (ARAMCO paid Saudi Arabia 22 cents a barrel). Kuwait also received a bonus payment of $7,250 million and an annual rental of $625,000 (about £223,214) until the discovery of oil. The company was also liable to give Kuwait on demand 15% of Aminoil's shares.[68] (Article 3.)

On September 22nd, 1949, the Company was granted another 60 year concession covering the islands of Kuber, Qaru, and Umm al-Maradim (Fig. 7) and their territorial waters extending to 3 miles.*

In 1961 Kuwait asked Aminoil for a revision of their concession agreement of 1948, in order to conclude an agreement more beneficial to the country. In July, 1961, the company reached agreement by not refusing to meet the country's demands while negotiating the revision of the concession in favour of Kuwait. Accordingly, Aminoil was to pay whichever of the following was greatest:-

(a) "57% of profits based on realisation", or

(b) "50% of profits based on posted prices."

The amounts due were to be discharged by the payment of:-

(a) "Royalty at 12.5% of the posted price of oil won or saved", and

(b) "Kuwait income tax, royalty being a credit against income tax."[69]

With regard to the Saudi share of the Zone, in 1939, ARAMCO secured oil rights, but did not take practical steps to develop them. In October, 1948, because of the terms of Aminoil's concession with Kuwait which was the highest in the Middle East at that time, especially when compared with the amount paid by ARAMCO to Saudi Arabia, ARAMCO surrendered all its rights over the Neutral Zone. The reason behind this might have been the refusal of ARAMCO to follow the example set by Aminoil in paying 33 cents a barrel while it paid 22 cents for its concession over Saudi Arabia's land. On the other hand, in return

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* The terms of this agreement are not available, but it could be similar to that of 1948.

for surrendering its rights in the Neutral Zone, it obtained oil rights over Saudi territorial waters.[70]

As a result of the above developments, in February, 1949, the Pacific Western Oil Corporation* obtained a 60 year concession covering Saudi Arabia's undivided half-share of the Zone. The terms of the Company's concession exceeded in their severity even those of Aminoil. Saudi Arabia was to receive a royalty of 55 cents a barrel, a bonus of $9.5 million, an annual rent of $1 million until the discovery of oil in commercial quantities, and 25% of the Company's shares.[71]

Both companies, Aminoil and Getty Oil Company, lost no time in arranging a working organisation, but not in a joint company. Each company has its own terminal and a separate administration. The oil produced is shared by the two companies, but sometimes, according to an agreement between the two, one company takes a greater percentage of the oil when it has more ability to market the oil than the other, e.g. in 1965 Aminoil took 55% of the total produced oil. Surveying and drilling of the area began in 1949 and oil was discovered in the Wafra area at a depth of 3,800 ft. In 1954, the first exports were made from the area.

The Kuwait/Saudi Neutral Zone Offshore Area

For a long time there had been a strong belief that oil could be found in abundant quantities in the offshore section of the Gulf. This belief was confirmed when ARAMCO discovered oil in the Safaniya and Manifa fields in the Gulf, offshore of al-Hasa in Saudi Arabia in 1957. As a result of the oil discovery in Safaniya and Manifa, the Neutral Zone offshore area became of great

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* On April 24th, 1956, the name of Pacific Western Oil Corporation was changed to Getty Oil Company.

interest to various oil companies, especially Japan Petroleum Trading Company. On December 10th, 1957, Saudi Arabia granted a forty year concession (starting from the discovery of oil in commercial quantities) for its own undivided half of the offshore of the Kuwait/Saudi Zone to this company.[72] On July 5th, 1958, Kuwait followed the Saudi Government's example by granting the same company a concession for its half share of the offshore area excluding the territorial waters of the Zone extending to 6 nautical miles offshore, the islands of Qaru and Umm al-Maradim and their surrounding waters extending to 3 miles. (Fig.7.) The concession was to run for 44½ years.[73] No figure was mentioned regarding the area of this concession, but during field work in 1970, the figure 5,976 sq. kms. was given by AOC.

The company was to exercise its concession rights through a subsidiary, the Arabian Oil Company, (AOC), which was formed in February, 1958, in Japan with a capital of £24.8 million. The company is owned by a group of Japanese companies, with the two interested countries, Kuwait and Saudi Arabia, each holding 10% of the total shares.[74] The following table shows the shareholders of AOC and their holdings.

Table 4 Shareholders in the Arabian Oil Company and their holdings of shares

No.*	Shareholders	No. of Shares
11	Electricity & Gas Companies	10,460,500
8	Steel & Metal Companies	7,208,000
7	Shipbuilding & Heavy Industry	2,207,000
2	Shipping Companies	1,820,000
11	Other Industries	2,492,000
9	General Merchant Companies	5,917,200
10	Insurance Companies	1,106,000
7	Security Companies	6,967,500
2	Foreign Governments (Kuwait & Saudi Arabia)	10,000,000
263	Individuals	1,821,800
330	Total	50,000,000

Source: Arabian Oil Co. Statement on Oil Operations Tokyo, Japan, 1958-1961, pp.10-11.

* The number of Companies, Countries, and individuals.

The financial terms of both agreements were similar, except that the Saudi Government was to receive 56% of the profits made by the Company (crude oil production, refining, transport, and marketing), while the corresponding figure for Kuwait was 57%.* Both governments were to receive a rental of $1,500,000, plus $1 million a year from the date of the agreement until the discovery of oil in commercial quantities, and a min8mum payment of $2.5 million after the discovery of oil. In addition, both governments were to receive 10% of the company's shares after the discovery of oil in commercial quantities, and they had the option of taking 20% of the oil in kind.[75]

From the contents of the agreement signed by Saudi Arabia and Kuwait, and AOC, it was evident that the latter company pursued a very generous policy in granting a fairly high percentage of profits, the like of which was never before granted by any other oil company to the oil producing countries in the Middle East.

It may be concluded that the attitude which was followed by the company towards Saudi Arabia and Kuwait suggests their total conviction of the high probability of finding oil in the area in quantities sufficient to give high commercial potential.

In concluding this chapter it is important to mention certain changes in the structure of concessions. The Middle Eastern countries in the period pre-Second World War concluded a number of oil concessions with different oil companies. At the time when these concessions were granted, certain circumstances ruled the area. The granting countries did not possess free will for one

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* E.H. Brown in his book The Saudi Arabia/Kuwait Neutral Zone mentions that "in another separate confidential letter agreement of the same date as the Saudi Agreement, the Company agreed to raise the terms and conditions given to the Saudi Arabian Government in order to make them correspond to any better terms given to the Shaikh of Kuwait."

reason or another; they were not sufficiently aware of what they were giving away; also, petroleum was not then the vital source of energy it later proved to be. Moreover most, if not all, of the granting countries were not only politically weak and dependent at the time, but also economically undeveloped, and this could have been the reason for their acceptance of any payments from the concessionaires. The terms obtained by the host countries more or less adhered to the following pattern:

(a) The concession area was large, covering the largest part of the state, if not all of it.

(b) The duration of the concession was rather long, usually running between 60 and 75 years (Kuwait's was 92 years).

(c) The financial terms were modest, a payment of royalty which was fixed at 4/- gold (84 cents) per ton of crude oil (Kuwait received payment in rupees).

However, after the Second World War, the host governments showed their disapproval of the fixed royalty system, because of the large profits made by the oil companies, as production had increased enormously. The nationalization of the Iranian oil industry in 1951 and the introduction of 50-50 profit sharing in the same year,may have caused this ill feeling.

In 1957, with the entry of the American independent oil companies and some European newcomers into the Middle East, a new departure from the 50-50 principle was established, i.e. when Iran signed a partnership agreement with AGIP. Nine years later Iran signed another controversial agreement, this time with ERAP. Under the terms of this agreement, NIOC retained overall responsibility for decisions, and the sole ownership of all oil produced, making ERAP, in effect, contractors rather than partners.

The present mood of the host governments was clearly indicated by Mr. Yamani, the Saudi Minister of Petroleum and Mineral Resources, during his talk at the American University of Beirut in 1969. He was against the nationalization of the oil industry in the producing countries, because he thought it would lead to the disintegration of the present structure of the industry and the collapse of prices. At the same time he was in favour of participation in the major international oil companies, both at the producing end and in the marketing. He believes that oil producing countries should aim to "preserve the stability of the present world oil price structure in order to maintain the unit revenues of the producers" and to "promote the growth of the national oil companies in order to secure an ever increasing role in the oil business for the producing countries", and these aims could be realised only by participation in operations.[76]

However, Professor Edith Penrose of London University, states that the large international firms may "fear partnership with governments". She believes that the oil companies might allow governments to own 50% of the shares, thus giving a semblance of partnership, but that it is unlikely that they would actually allow the governments to have 50% of influence over the company, or half of the profits. She feels that they would probably be afraid that governments would meddle in company business on political grounds, or that the governments would reduce the companies' control over their output, thus adversely affecting prices, and restricting the companies' management of their international operations.[77]

Relinquishment

Very large areas, and sometimes whole countries were covered by the first concessions granted in the Middle East, and no provision was made in the agreements for relinquishment.

In 1925, the agreement between Iraq and IPC included some relinquishment, which was never implemented, and was eventually omitted from the revised agreement of 1931. ARAMCO and Saudi Arabia also included the surrender of certain parts of the concession area, to be chosen by the Company. However, in 1948, ARAMCO agreed to a programme of gradual relinquishment.

By 1957, IPC and its affiliates had held some concessions for over 30 years, and had made no real attempts to explore and prospect all of it. At the end of that year, Iraq asked IPC to relinquish a part of its concession area.

After much bargaining, the government finally proposed that IPC should retain 2% of the area under concession, 90% would be immediately relinquished, and 8% would be developed by a new company in which Iraq was to have 20% participation.

On IPC's rejection, in 1961, of this proposal, the government passed a law compelling the company to relinquish 99.5% of its concession area, leaving 1,935 sq. kms. of actual producing fields to the company.

This was the famous Law No.80, which had as great an effect on the changes in the oil industry as the nationalization of Iran's oil in 1950. Its influence was felt by the major oil companies all over the Middle East, who had to accept the idea of relinquishment despite their obvious reluctance.

Law No.80 led to ARAMCO's agreement in 1963 to relinquish all of its concession area exceeding 125,000 sq. miles, and other areas at 6 intervals of 5 years each, thus leaving ARAMCO with 20,000 sq. miles after 30 years.

In spite of the fact that the big oil companies were not keen on the relinquishment concept, they still kept under concession areas containing more oil reserves than they are likely to use even to the end of their contracts. There is more oil than they can properly market internationally, so naturally they are not as keen to explore and prospect their area as a newcomer would be. Therefore, host governments have to follow up relinquishments rigorously, and they have been asked to start a schedule of quicker, more progressive relinquishment to apply to oil agreements already in force.

This, however, is not the whole solution, as which party should decide the acreage to be relinquished is also an important question. To date, the company has usually been the one to choose, and naturally enough, they tend to select areas which show little promise. A stipulation is now being added to present and future agreements, which states that the government is to have a part in deciding the acreage to be relinquished, and to approve the choice.[78]

NOTES

1. L. Lockhart, Iranian Petroleum in Ancient and Medieval Times, reprinted from the Journal of the Institute of Petroleum, Vol.25, No.183, January, 1939, p.1.
2. Petroleum Information Bureau, (P.I.B.), Oil - an Introduction, London, pp.1-2.
3. Lockhart, op. cit., pp.2-3.
4. P.I.B., Memorandum - Oil in the Middle East, October, 1962, London, p.3.
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CHAPTER III

REGIONAL PRODUCTION

1. Reserves

In discussing oil exploitation, it is essential to determine the oil reserves of each country and region, since these determine production flexibility. Although it appears that the larger the oil reserves, the greater the production should be, there are many other factors to be considered. Among these are political stability, the market situation, and the gravity of the oil produced. However, the volume of reserves does have some bearing on production, as it sets an upper limit. Also, modern techniques have taken a great deal of the guesswork out of the estimation of the size of reserves. Table 1 gives a set of estimates of reserves in the three countries under study, compared with those of others in the world, from 1945 to 1970 in five-year intervals. An obvious feature of this is the vast rise in Middle Eastern oil reserves, (mainly in the countries bordering the Gulf), the average rate of increase every five years is 103.3%, compared with 77.5% for the rest of the world.

Table 1 World crude oil reserves 1945 - 1970 (million Barrels)

Western Hemisphere	1945	1950	1955	1960	1965	1970
U.S.A.	20,500	24,600	29,560	31,615	31,352	37,012
Venezuela	5,600*	9,000*	12,000	18,500	17,366	14,000
Others	1,900	3,000	5,723	17,590	15,978	22,935
Subtotal	28,000	37,600	47,283	67,705	64,696	73,947
% increase	(32.6)	(27.1)	(43.1)	(-4.4)	(14.3)	

cont'd....

Table 1 (cont'd)

Eastern Hemisphere	1945	1950	1955	1960	1965	1970
M. East:						
Iran	5,500	7,000	27,000	35,000	40,000	70,000
Iraq	4,000	5,100	20,000	27,000	30,000	32,000
Kuwait	4,000	11,000	40,000	62,000	70,000	67,100
S. Arabia	2,000	9,000	37,000	50,000	63,000	128,500
Others	200	300	2,206	7,085	25,000	46,974
Subtotal	15,700	32,400	126,206	183,085	228,277	344,547
% increase		(106.5)	(289.5)	(45)	(24.7)	(50.9)
Africa:						
Algeria	-	-	-	5,200	6,300	30,000
Libya	-	-	-	-	13,000	29,000
Nigeria	-	-	-	-	2,500	9,300
Others	-	-	-	2,350	1,178	6,257
Subtotal	-	-	-	7,550	22,978	74,757
% increase					(204.3)	(225.3)
World total	51,200	76,400	188,817	304,545	364,961	611,397

* Represents 1944 and 1949

Sources: Zuhayr Mikdashi, A Financial Analysis of Middle Eastern Oil Concessions (1901 - 1965), New York, 1966, p.9.
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Most of the Middle Eastern oil reserves have been discovered since World War II, and since then the centres of proven reserves have begun to move away from the Western Hemisphere. Of all producing countries in the world, Saudi Arabia, Kuwait, and Iran have the greatest known oil reserves, estimated at 11,500 million barrels in 1945, and rising to 147,000 million barrels in 1960, and to 265,000 million in 1970. The proven reserves in these three countries account for 76.9% of the total known reserves in the Middle East, and its proportion of proven oil reserves in the world in 1970, was 43.3%.

However, due to new finds of oil in North Africa, Alaska, the North Sea, and elsewhere, the share of Saudi Arabia, Kuwait, and Iran in the known world reserves increased by only 38.7% between 1960 and 1970, compared with 703.9% in the previous ten years. It is believed that the reserves will decrease in the long run if no new fields are discovered. To illustrate the extent of holdings of proven oil reserves compared with other regions, the present (1970) Saudi percentage of world reserves (21%) surpasses those of all the American countries, which together have only 12.1%. The result is that American countries have much less flexibility in the exploitation of their reserves than Saudi Arabia. It is almost impossible for the United States and Venezuela to sustain a rapid expansion of production.

Middle Eastern production has not been commensurate with the proven reserves, as shown in Table 2. U.S. production amounted to roughly 10.57% of its reserves in 1970, while in contrast, in the Middle East the figure is on average less than 2%.

Table 2 Oil production as a percentage of reserves

	1945	1950	1955	1960	1965	1970
U.S.A.	8.3	8.0	8.32	8.3	9.2	10.6
Venezuela	5.7	6.0	7.04	6.0	7.8	10.1
Iran	2.4	3.4	0.45	1.1	1.8	2.0
Iraq	0.9	1.0	1.24	1.3	1.6	1.7
Kuwait	-	1.1	1.01	1.0	1.2	1.5
Saudi Arabia	1.0	2.2	0.95	0.9	1.2	1.0

Source: Table 1 and B.P. Statistical Review of the World Oil Industry 1954 and 1969; the Financial Times, January, 1961.

In 1969, oil reserves per well in the United States were about 60,397 barrels, in Venezuela - 15.7 million barrels, as compared with 330.9 million in Saudi Arabia, 206.7 million in Iran, and 91.7 million in Kuwait.

2. Factors influencing the economics of oil production

The production of oil in any country must be related to world demand, and to its own reserves. The ability of any producer to compete in world markets is dependent primarily on its costs of production, and also on transport costs to consuming points. The vital question of production costs is governed by a number of factors; these are mainly the physical ease of extraction, the specific gravity of the oil, the production method employed, and the cost of labour.

In addition to their proven oil reserves, the countries concerned have several advantages in oil exploitation which lead to the cost of production being lower than many of their foremost competitors in world markets. The cost of crude oil production is recognised as the total expenditure which the company incurs on oil production from the time of extraction until it reaches the tanker loading terminal, and including the depreciation cost while excluding investment expenditure, royalties, and refining costs.[1] The cost of production in Middle Eastern countries is only about 7.7 U.S. cents per barrel on the average, while in Venezuela it is 62 cents, in U.S.S.R. 80 cents, and in the United States 151 cents. The cost of production of oil in the important countries in the four major oil producing areas has been given in the following table.

Table 3 Crude oil production costs

Area and Year	Operation Cost (cents per barrel)	Development investment per initial daily barrel	Development cost (cents per barrel)	Total cost (cents per barrel)
U.S.A. 1961-62				
Texas	18	3,250	138	156
Louisiana	10	2,542	108	118
Total	17	3,155	134	151
Venezuela 1962-64	6.2	863	55	62
Africa 1963-64				
Libya 1963-64	2.2	149	13(a)	15
Algeria 1962-64	3.9	656	42(b)	46
Nigeria 1964	2.7	590	28	31
The Gulf 1962-64				
Iran	1.0	130	6	7
Iraq	1.2	69	3(c)	4
Kuwait	1.8	167	8	10
Saudi Arabia	1.5	160	8	10

(a) Including 6 cents pipeline cost.
(b) Including 10.7 cents pipeline cost.
(c) No pipeline allowance since Kirkuk Field has net transport advantages in pipeline outlet to East Mediterranean, and cost comparison is on the Gulf basis.

Source: Naft al-Arab, No.6, March, 1970, Beirut, p.10 and P.P.S., May, 1966, p.178.

Since 1964, there has been little or no information about rises in the cost of production, however, it is believed that the position is now as follows. The average cost of producing one barrel of oil in the Middle East is about 15 cents. However, the cost in Iran is 13 to 14 cents a barrel, 8 or 9 cents in Saudi Arabia, about 6 cents in Kuwait, and even less in Iraq. The Iranian high cost is partially because the Iranian oil industry has over the years become heavily over-manned. The comparable figure for Venezuela is 51 cents, for Indonesia 82 cents, and

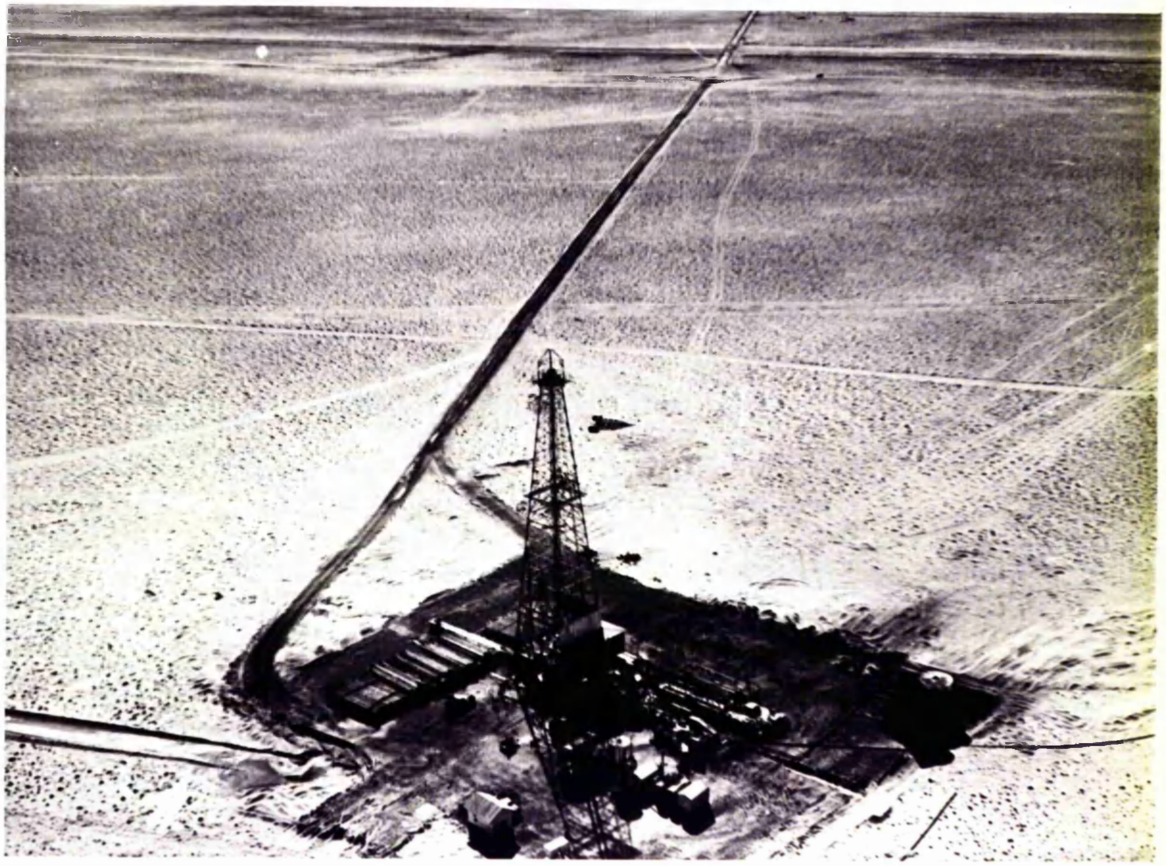

Plate 2 - An aerial view of an operational drilling rig in Kuwait.

for the United States 131 cents.[2]

The reason for Iraq's low figure is the lack of exploitation effort during the past 7 or 8 years, due to a dispute between IPC and the government. As any exploration costs are reflected in the cost of production, Iraq's costs have remained low.

In conclusion it is possible to say that the countries concerned can compete very favourably in world markets with rival producers, especially the American and African countries. The low cost of production is discussed under the headings of extraction, production methods, topography, and labour costs.

<u>Ease of Extraction</u>

In Kuwait, Saudi Arabia, and Iran, it is not necessary to drill deep to find oil. In Kuwait the average depth of a well is between 3,500 and 8,000 feet, while in Saudi Arabia it is around 7,000 feet, and in Iran it ranges from 3,000 feet (these are shallow wells) to 10,000 feet. Often these wells have a dual producing capacity (i.e. they are drilled in a position that penetrates through two oil producing strata).

Usually the operation time taken to drill an exploratory well is longer than that taken for a development well. To drill an exploratory well in the offshore area may take 5-6 months, while the time would be reduced to 3-4 months for a development well. Onshore, however, the length of time needed to drill an exploratory well is about 4 months, while a development well would take about 2 months.[3]

The further down one has to drill, the more expensive the operation becomes. However, as a result of improvements in equipment and technique in almost all phases of drilling operations, the time and costs of drilling have been reduced. For example, in Saudi Arabia in 1960 it was possible to drill at an average rate of 99.3 feet per day in development drilling, while in 1968 the average penetration increased to 419 feet per day. The table below shows the average penetration per foot on the onshore of Saudi Arabia.

Table 4 Onshore drilling in Saudi Arabia – 1958–68

Year	Average rate of penetration – foot/day Exploratory Wells	Development Wells
1958	52.58	114.26
1959	48.69	107.58
1960	–	99.30
1961	–	177.38
1962	–	157.56
1963	88.73	136.38
1964	75.00	180.02
1965	141.34	314.76
1966	115.68	298.07
1967	166.84	316.36
1968	150.71	419.04

Source: See source of Table 5.

In 1958 the average exploration drilling cost per foot was \$139.17, and in spite of a drop to \$45.33 in 1965, it rose again in 1967 and 1968, because of deep exploration drilling in parts of the Rub al-Khali, which was expensive due to the difficulties of the terrain and the distance from the supply base.

During the 1960's the average development drilling cost per foot was reduced from \$71.35 in 1960, to \$39.66 in 1965, and to \$31.86 in 1968. Thus a 55.4% reduction in the cost of development drilling was achieved by Saudi Arabia. The following table shows the average cost of drilling in the onshore areas of Saudi Arabia.

Table 5 The average cost of onshore drilling in Saudi Arabia - 1958-68

Year	Average cost of drilling $/ft.	
	Exploratory Wells	Development Wells
1958	139.17	70.04
1959	116.30	69.38
1960	-	71.35
1961	-	46.95
1962	-	48.73
1963	59.62	47.70
1964	69.59	48.95
1965	45.33	39.66
1967	95.25*	36.59
1968	107.68*	31.86

* The cost of exploratory wells is high for the years 1967 and 1968 because some of these wells are located in the Rub al-Khali.

Source of Tables 4 and 5 is Drilling Techniques and Cost in Saudi Arabia by A.K. Ghalayini, a paper presented to the Seventh Arab Petroleum Congress, Kuwait, March 16th-22nd, 1970.

Although no information is available with regard to these costs in Kuwait and Iran, it is believed that they must be fairly similar. In contrast to Saudi Arabia, the U.S. producing industry is drilling an increasing number of wells to about 15,000 feet each year in its search for commercial gas and oil deposits. Deep well costs are increasing. During 1958-62, it cost an average of $756,000 to drill a deep exploratory well, and in 1966 the average cost was $1,286,000.[4]

Collectively, Iran, Saudi Arabia, and Kuwait have the highest rate of production per well in the world. Also, when considered separately, each of these countries has a higher rate than other oil producing countries. The average daily production in Iran in 1969, was 14,164 barrels per well, while in Saudi Arabia the figure was 6,973, and in Kuwait it was 3,416 barrels per well. Comparative figures for the United States and Venezuela are 12 and 361

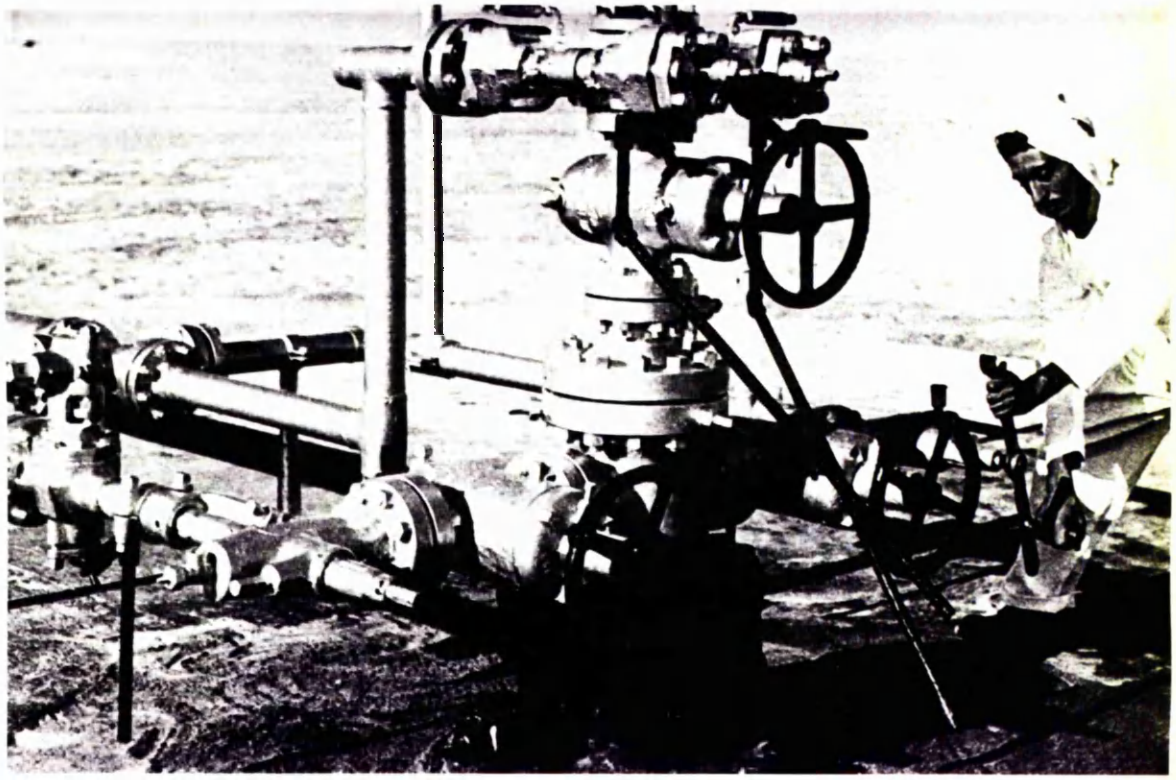

Plate 3 - A well producing oil by natural pressure.

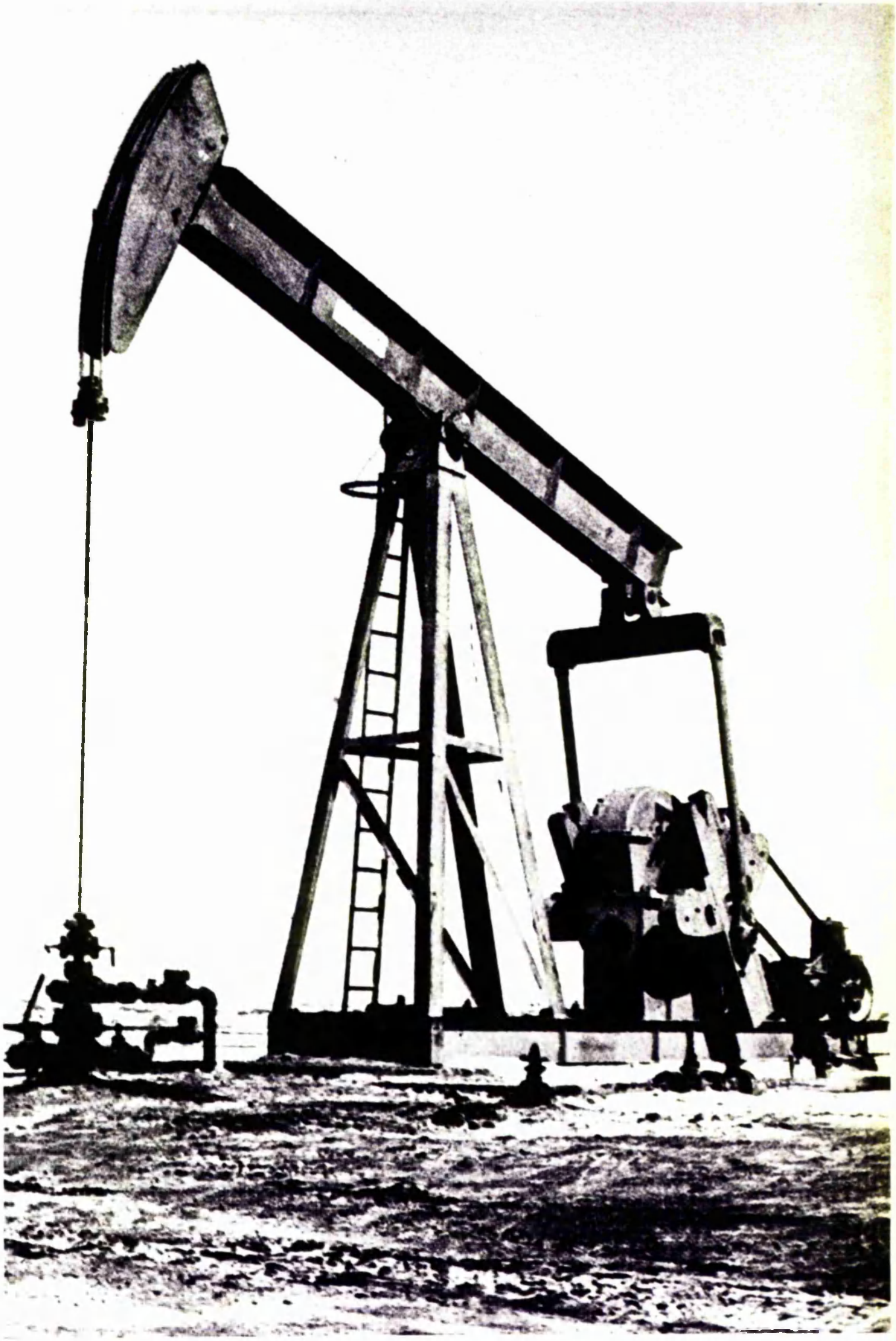

Plate 4 - A pumping unit operating on a producing oil well.

barrels per well, respectively.[5]

Raising oil to the surface

In most oil producing countries, especially the United States, the Soviet Union, and Venezuela, pumping systems have to be used in order to bring oil up to the surface, because of the lack of sufficient pressure of natural gas in the wells. In 1969, in Venezuela, 68.63% of a total 9,909 wells were dependent on pumping, while in the United States the percentage was higher. In contrast, all the producing countries around the Gulf have an abundance of natural gas in the reservoirs, which pushes the oil to the surface by natural pressure. This, however, excludes the onshore area of the Kuwait-Saudi Neutral Zone. The advantages of this natural gas pressure are that it speeds the rate of production and reduces the labour and power which are necessary in running a pumping system, with the obvious implication for reducing the cost of production.

Topography

In any country, topography plays an important role in determining the cost of production. In the countries being dealt with, the effect of the relief is clearly noticeable. Although they are known for their low cost of production, each country has its own particular advantage over the others.

Kuwait and Saudi Arabia have the advantage over Iran in that Iran's major oilfields are in the mountains, with the exception of a very few on the plains, and in order to have access to these, costly roads have to be constructed. Another expense incurred in Iran is the cost of maintaining personnel in production units in remote areas. Also the mountainous terrain renders pipe-laying more difficult and expensive.

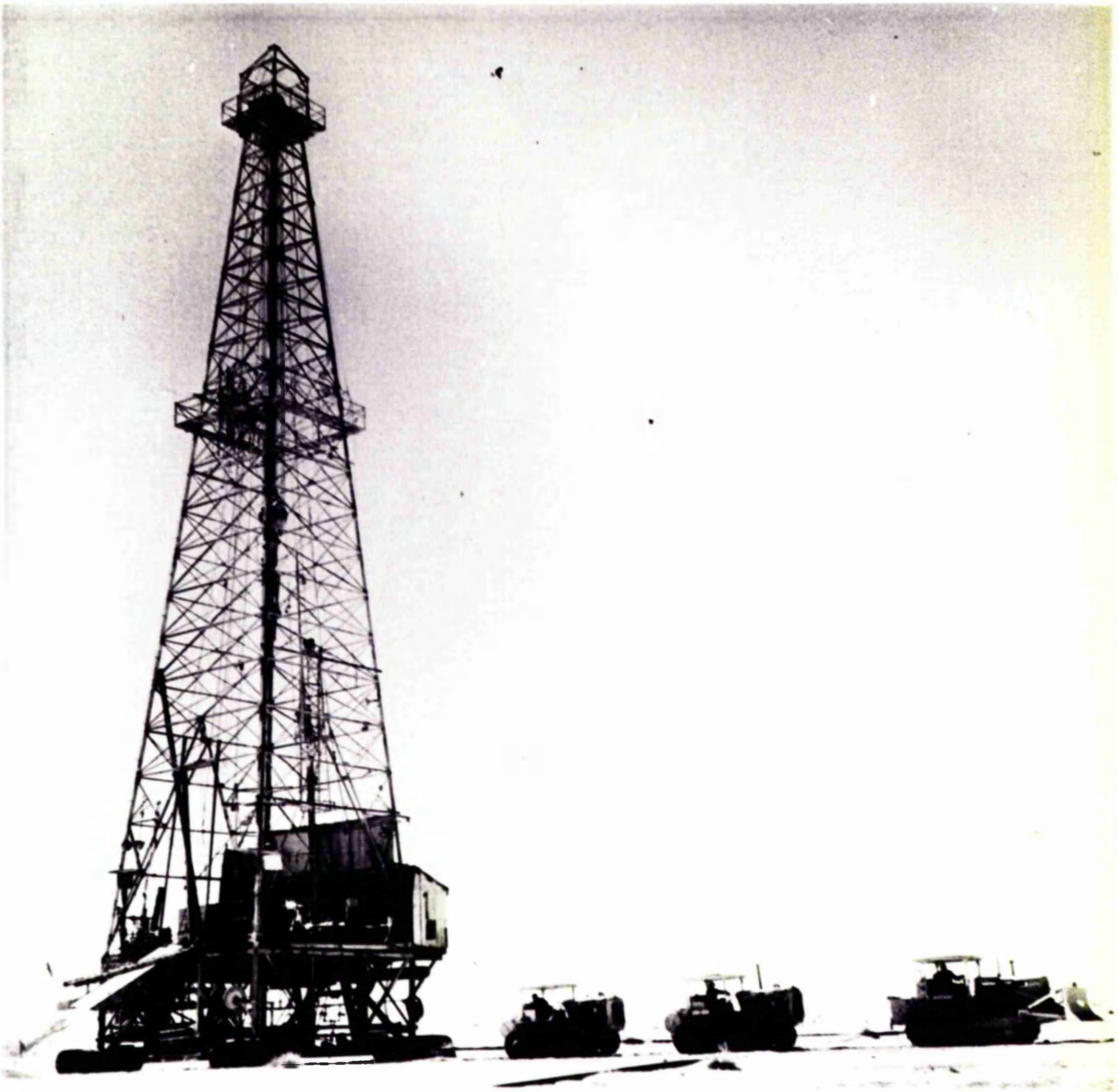

Plate 5 - Moving a drilling rig from one site to another in Kuwait.

Kuwait has several advantages over both Iran and Saudi Arabia, and the major one is the terrain. The relatively flat and barren countryside makes it possible to move drilling rigs by towing them to their new locations, without having to dismantle them. Also, the wells are located fairly close to each other. Another advantage of the terrain is the convenient location of a ridge between the fields and the coast. Ideal conditions for the storage of petroleum are provided there, and oil flows down to the terminal on the coast by force of gravity, without pumping, thus reducing costs. In Kuwait, the concession area is much smaller than the others, and the fields are adjacent to each other and to the shore, which again cuts the costs of production by reducing the number of pumping stations and length of pipeline required.

Iran's main advantage is the high production capacity of her wells. It is possible to produce over 100,000 barrels per day from some wells. Thus Iran is able to produce oil at a cost as low as the other two countries.

Labour costs

A large number of people are employed in the various concerns connected with the oil industry in the Gulf area. These employees are both local and foreign, the foreign element falling into three categories. Top administrative and technical posts are mostly filled by Europeans and Americans, while clerical and skilled labour is provided by Pakistanis and Arabs from the Levant. Semi- and unskilled labour is provided by immigrants from other parts of the Gulf when there is not sufficient available locally. In Kuwait, Qatar, and Bahrain, this is particularly true, and foreigners play leading roles in most branches of the economy. However, the proportion of foreigners is declining, particularly in Iran and Saudi Arabia, where they are being replaced by local people. In

Kuwait, the situation differs in that the decrease is only in non-Arabs, who are being replaced by Arabs. The following table shows the numbers of employees in four major oil producing countries of the Gulf.

Table 6 Comparative numbers of employees in oil companies in the Middle East (in thousands)

Year	IOOC & NIOC Non-basic	ARAMCO	KOC	IPC
1960	43.1	14.8	7.2	13.4
1961	38.8	14.1	6.2	12.9
1962	33.3	13.6	5.8	14.2
1963	41.4	13.0	5.6	11.5
1964	30.7	12.9	5.4	11.2
1965	29.6	12.8	5.3	11.1
1966	28.2	12.7	5.2	11.0
1967	25.9	12.0	5.1	-
1968	23.2	11.5	5.2	-
1969	20.8	10.8	4.9	-

Sources: Iranian Oil Operating Companies' Statistics, 1967, Annual Reviews 1968 & '69; ARAMCO, Facts and Figures 1969; Kuwait Oil Company Annual Reviews, 1967, '68 & '69.

The most remarkable features of the above table are, firstly, the continuous reduction in the number of employees, and secondly, that while Iran has the highest figures, Kuwait has the lowest. The number of employees in Iran was reduced by 51.74% between 1960 and 1969, while those in Saudi Arabia were reduced by 27.02%, and in Kuwait by 31.94% for the same period. The reduction can be related both to automation and to an attempt to reduce the cost of production. This latter is very true in the case of Consortium, where employment in non-basic work is particularly high, as shown in Table 7. Although the number of these workers has decreased by 40.61% between 1961 and 1969, the amount is still 39.48% of the total personnel employed by Consortium.

Table 7 Salaries and wages paid by the Iranian Oil Operating Companies

Year	Non-basic operations	Basic operations	Total personnel	Total Payment ($ million)
1961	13,880	24,939	38,919	78.6
1962	12,875	20,407	33,282	79.2
1963	12,345	19,024	31,369	61.0
1964	11,908	18,800	30,708	63.5
1965	11,603	18,054	29,657	65.5
1966	10,946	17,300	28,246	71.4
1967*	10,155	15,763	25,918	90.1
1968	9,012	14,204	23,216	83.2
1969	8,243	12,635	20,878	86.6

* From this year the figures include employees' benefits (the company's contribution to social insurance organisations, pension and savings schemes, and leave pay).

Sources: Iranian Oil Operating Companies, Annual Reviews, 1965, '66, and '69.

However, it is to be noted that wages paid in the oil industry in the Middle East are higher than those paid to workers in other branches of the economy. Also, wages have been steadily rising, while in other major oil producing countries, i.e. Venezuela and the United States, they are only a small part of the total wage bill. The following figures illustrate the relative level of wages paid in the oil industry in the Middle East as against other major producing areas. In 1945, the minimum daily wage in Saudi Arabia was 40 cents. This rose to 81 cents in 1950, $1.62 in 1955, and $2.13 in 1958. In Iran in 1948, it was $1.50*, in 1955-56 it was $1.08, and in 1957, $1.30. In Iraq in 1948 the minimum wage was 90 cents, $1.10 in 1950, $1.60 in 1955, and $1.80 in 1959. In Kuwait in 1959, it was $1.79, and in Venezuela in

* The rial (local currency) was greatly overvalued in the early years. The rise was from 40 rials in 1948 to 82 rials in 1955-56, and to 99 rials in 1957.

1950 it was $2.00, and $3.70 in 1959.[6]

As regards average annual income, for employees of the Kuwait Oil Company this was $1,500 in 1958, and about $1,700 in 1959. Saudi Arabian employees in Saudi Arabia had their annual earnings more than doubled between 1953 and 1959, when the figure reached $1,888. In the United States, average annual earnings were $3,470 in 1948, in petroleum and natural gas production, and $3,750 in refining. In 1958 the figures were $5,700 and $5,970.[7]

A number of striking points are revealed by the above figures. In 1959, the Kuwaiti minimum daily wage of 170 cents was less than 50% of that of Venezuela. Furthermore, within the Middle East, costs were lowest in Kuwait. Equally striking, however, is the obvious narrowing of the difference between the Middle East producers and Venezuela. Thus, for example, in 1950, wage rates in Saudi Arabia were only 20% of those in Venezuela, but they had increased to about 60% in 1959. The Kuwaiti annual payrolls were only about 12% of those in the United States in 1958. The high cost of labour in Venezuela and the United States contributes to the higher cost of oil production in both countries, and thus they cannot compete successfully with the countries under study in world markets.

Although recent exact figures are not available, it is known that since 1959 in Iran, Saudi Arabia, and Kuwait, wages generally have risen by over 50%, associated with increased revenues from oil, and the consequent rise in the standard of living. As made clear by Table 8, the annual average income of a Saudi Arab was increased from $2,187 in 1963 to $2,835 in 1966, and to $3,399 in 1969 - an increase of 55.41% over 7 years. Even so, this remains lower than the wages in the United States and Venezuela, but if the upward trend continues, the Middle East will soon cease to enjoy any competitive advantages in terms of cheap labour.

Table 8 Average annual income of Saudi Arab employees

Year	Saudi employees	Payments ($)
1963	10,391	2,187
1964	10,299	2,374
1965	10,257	2,605
1966	10,238	2,835
1967	9,813	2,975
1968	9,452	3,148
1969	9,015	3,399

Source: ARAMCO Statistical Review, and ARAMCO Facts and Figures, 1969.

3. Production in various countries

At present, more than 30% of the world's oil is supplied by 4 major areas. These are North America, (mainly the United States), the Middle East, the Caribbean, and the Soviet Union. Other, lesser producing areas are North and West Africa, and the Far East. During recent years, some fundamental changes have occurred in the oil trade, and in each area's share in the production totals. Figure 1 shows the development of oil production in the major producing countries.

The most notable aspect of the period since World War II is the increase in production in the Middle East. A good example is Saudi Arabia, which started exporting oil after 1945, and in 1969 was the fifth biggest producer in the world, after the United States, the Soviet Union, Venezuela, and Iran, with a production of 160.2 million tons. Apart from the main producers around the Gulf, (Iran, Saudi Arabia, Kuwait, Iraq, Qatar, and Bahrain), there are other areas now producing oil, such as Abu Dhabi, Dubai, and Oman, which started production in the early and mid-1960's.

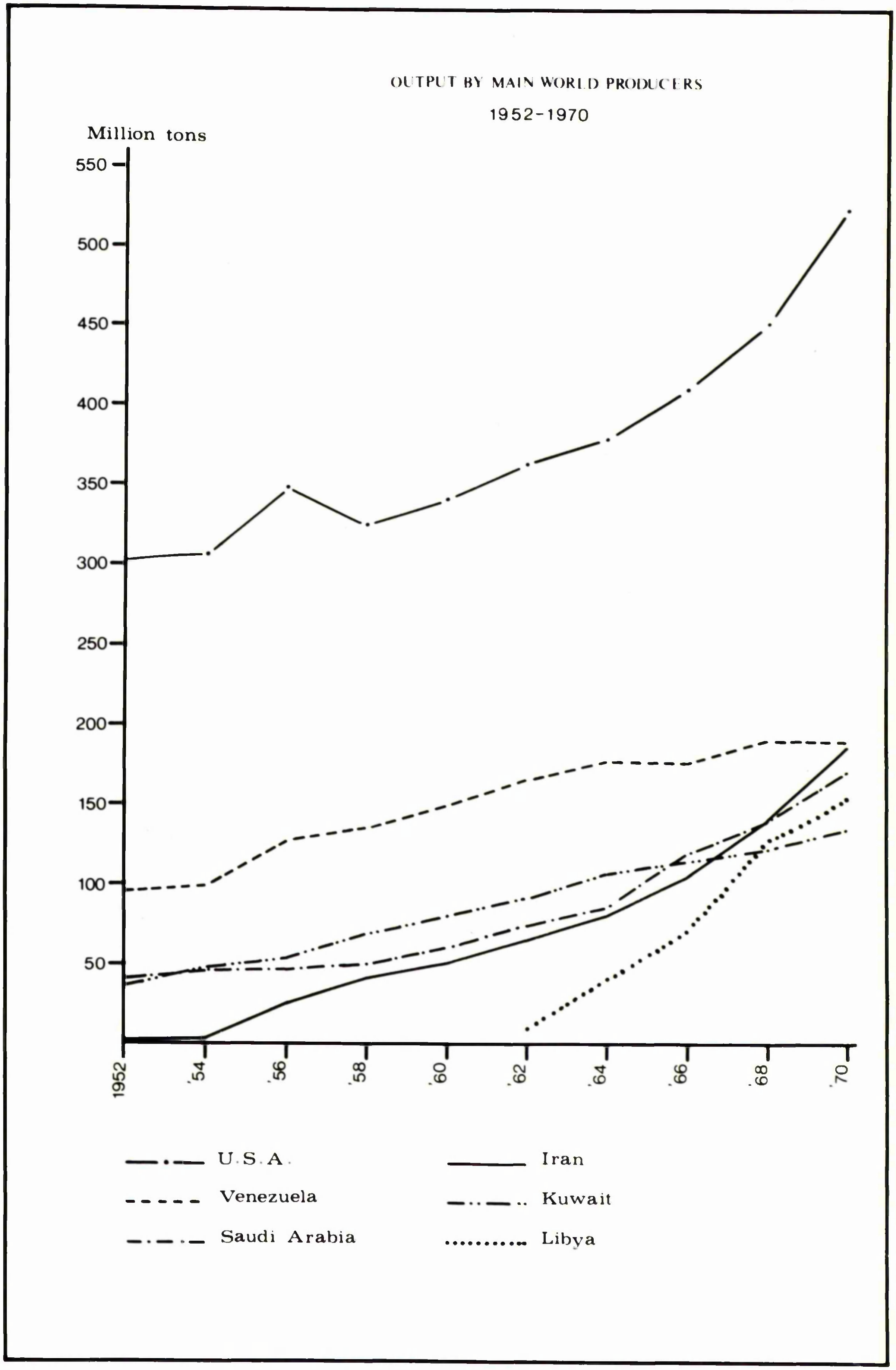

Fig. 1 - The development of oil production in the major producing countries - 1952-1970.

In recent years, the output of the Middle East has increased greatly, with Iran, Saudi Arabia, Kuwait, and Iraq being the main contributors. Production in the Middle East has increased from 261.8 million tons in 1960, to 415.5 million tons in 1965, and to 697.1 million tons in 1970. This increase has mainly been due to new oil discoveries around the Gulf, and to rising world demand for oil.

Political issues sometimes have great influence on oil production. The temporary halt in Iranian output following the nationalisation of 1951, led to increased demand for oil from other producers, and a consequent stimulus to increase production in Kuwait and elsewhere. Conversely, in 1967, because of the Arab-Israeli War, and the oil embargo on the United States, the United Kingdom, and West Germany by the Arab countries, production in Iran was increased to fulfil the needs of these countries.

Large new fields were discovered in North Africa, in Libya, Algeria, and Egypt. Libya, which started production in 1961, had an output of 156.4 million tons in 1970, which exceeded Kuwait's production, and placed Libya in sixth place in the world. This tremendous increase in Libyan output is due in part to its geographical position, near to the consumers of Western Europe, reducing the distance which the oil has to travel. Another factor is the quality of the Libyan oil, which contains less sulphur than most oil, making it more desirable to the consumer. Also, oil companies trying to recover their initial outlay tend to push up the production in their Libyan areas, regardless of the danger of exhausting the fields. The following pages deal with production from Iran, Saudi Arabia, and Kuwait.

a. Iran

The first oil discovered in the Middle East was found in Iran by the D'Arcy concessionairs in 1908, 7 years after the concession was granted. The discovery was made at Masjid-i Sulaiman, in the south-west of Iran. By 1911, control of both the oilfields and the Abadan refinery was in the hands of The Anglo-Persian Oil Company*, and in 1914, this company signed a contract with the British Admiralty, which led to the rapid expansion of the Iranian oil industry. The contract was for the long-term supply of fuel oil to the British Navy, while at the same time, the British government bought a controlling interest in the Anglo-Persian Oil Company. Thus, during and immediately after the First World War, production expanded from 655,735 tons in 1917, to 1,124,170 tons in 1919. In 1929, production was again increased when Haft Kel Field started producing, and in 1937 a further increase was recorded as Gach Saran Field was commissioned. Major discoveries were also made at Naft Safid, Lali, Agha Jari, and Pazanan.

The advent of the Second World War, and the closure of the Mediterranean led to a drop in production in Iran from the pre-war figure of over 10 million tons. However, in 1944, production was up to 13.7 million tons, and an even greater increase was recorded in 1945, when the Agha Jari and Naft Safid fields were put into production. By 1949, Iran was producing 27.6 million tons of oil per year, and of this, 25 million tons were exported as crude oil or products. In 1950, Iran was the major oil producer in the Middle East area, with a production of 32.8 million tons.

The nationalisation of the Iranian oil industry on May 1st, 1951, due to a dispute between the Iranian government and the Anglo-Iranian Oil Company, led to a steep drop in production. The same year, production was only 16

* The Anglo-Persian Oil Company changed its name to Anglo-Iranian Oil Company, in 1935.

million tons, and in 1952 and 1953 it had dropped to 1 million tons. At this time, exploitation of other oil sources in the Gulf (particularly Kuwait), began to expand rapidly.

A group of international oil companies, including British Petroleum (formerly AIOC), had reached an agreement with the Iranian government in October, 1954. Thus, these companies, acting under the name of the Iranian Oil Participants (generally called Consortium), undertook oil exploration in Iran. The Agreement Area includes the fields of Agha Jari and Gach Saran, which are the main producing fields. In 1967, Agha Jari produced an average of 909,000 barrels per day, and Gach Saran produced 665,000 barrels per day, while a net total of 2,467,000 barrels per day was obtained from Karanj, Faris, Marun, Ahwaz, Haft Kel, Masjid-i Sulaiman, Lali, Bibi Hakimeh, Naft Safid, Pazanan, Kharg, Ramshir, Rag-e Safid, and Binak, the other fourteen fields in the area.[8] While Gach Saran supplies important quantities of heavy crude, the Consortium's higher exports of light crude have increased the value of the Agha Jari Field. The following tables show the net production per field, and the number of producing wells for different years.

Table 9 Net crude oil production by fields, and the percentage of increase 1963-69 (million barrels)

Field	1963	1965	%	1967	%	1969	%
Agha Jari/Karanj/ Marun/Faris	286.6	329.1	14	429.9	30	561.8	30
Gach Saran	130.7	185.7	42	422.6	127	264.4	-37
Ahwaz	35.4	60.7	71	59.6	-1	87.5	46
Haft Kel	47.0	38.0	-14	28.0	-26	17.8	-36
Bibi Hakimeh	-	14.0	-	83.2	494	134.6	61
Pazanan	-	6.6	-	20.4	209	14.8	-27
Masjid-i Sulaiman/ Lali	17.5	14.3	-18	12.9	-9	8.8	-31
Naft Safid	10.0	8.5	-15	7.9	-7	11.3	43
Kharg	-	3.0	-	4.8	60	7.2	50
Ramshir	-	-	-	3.1	-	1.7	-45
Rag-e Safid	-	-	-	7.9	-	8.5	7
Binak	-	-	-	-	-	13.3	-
Total:	527.2	659.9	-	900.3	-	1,131.7	-

Table 10 Number of producing wells in different fields 1963-69

Field	1963	1965	1967	1969
Agha Jari/Karanj/ Marun/Faris	38*	46	64	68
Gach Saran	12	22	24	26
Ahwaz	7	20	23	18
Haft Kel	15	15	10	10
Bibi Hakimeh	-	3	17	12
Pazanan	1	4	3	1
Masjid-i Sulaiman/ Lali	29**	32	29	22
Naft Safid	15	16	15	11
Kharg	-	4	4	2
Ramshir	-	-	2	1
Rag-e Safid	-	-	3	2
Binak	-	-	1	1
Total	117	162	195	174

* This figure applies only to Agha Jari.

** Of this figure, 26 refer to Masjid-i Sulaiman, and 3 to Lali.

The sources of Tables 9 and 10 are: Iranian Oil Operating Companies, Annual Reviews, 1963, '65, '67 and '69.

The above two tables show clearly that although the output from some fields is increasing steadily, others are decreasing just as steadily. Two examples of the increase are Agha Jari, which increased its output from 286.6 million barrels to 561.8 million barrels during the period 1963-69; Bibi Hakimeh, where production rose from nil to 134.6 million barrels in the same period. However, production from old fields subh as Haft Kel, Masjid-i Sulaiman, Lali, and Nafd Safid, has dropped sharply. Haft Kel, for instance, produced 47 million barrels in 1963, but only 17.8 million in 1969. This situation also applies to producing wells, as can be seen in Table 10, and can be related to several factors.

The first and most obvious reason is the exhaustion of the reserves of oil, and, in fact, an intensive well repair programme was carried out in 1963, in order to increase the level of production from the declining fields.[9]

The second reason may be that the company has discovered new fields with large reserves, close enough to the shipping points to render it more economical to increase production from these than to improve on the old fields, and transport the oil long distances. Also present world demand is concentrated on two kinds of crude oil - light and heavy, and although Lali and Masjid-i Sulaiman could supply these, two fields situated close to Kharg, the shipping point, are more economical, and their relative reserves are much greater. They are Agha Jari which is well known for its light crude, and Gach Saran for its heavy crude, and their positions cut the cost of transporting the oil.

As a result of pressure on Consortium from the Iranian government in 1966, exploration activity in the concession area was greatly stimulated. The government was pressing for the entire area to be worked, or handed back, and this eventually led to the discovery of four new fields in 1967. Two minor fields were Susangerd and Par-e Siah, and two others which were classed as significant discoveries were Kilur Karim and Chesmeh Kush. Also in 1967, a second phase of development was completed at Bibi Hakimeh, and at the end of the year the Binak Field started production.

Maleh Kuh (143 miles north of Ahwaz), Shadegan (38 miles south-east of Ahwaz), and Lab-e Safid, north-west of Lali Field were discovered in 1968.[10] (See Fig.2.) During recent years, however, defining known fields has been the main work of the Consortium, and it has shown great success, for example, in the discovery that the Marun Field is 70 miles long and its reserves are correspondingly large.

At the time of the nationalisation of the Iranian oil industry (1950), Iran produced some 37.5% of the Middle East's total production, and her share of the world's total was 5.9%. Thus Iran was leading the rest of the Middle East in oil production. After the settlement in 1934, production in Iran began to rise again, and in 1956, production levels exceeded those of 1950. The increase of 1956 over 1955 was 10 million tons (from 16 to 26 million), which was an increase of 62%. This jump in production can be related to the Suez Crisis of 1956, when the Arab countries ceased all oil exports to Western Europe, causing a shortage. Iran's operations were limited by the closure of the Suez Canal, however, as there were insufficient numbers of large tankers to move the oil via the Cape and meet European needs.

From then, production rose steadily until 1967, when the outbreak of the Arab-Israeli War, and the subsequent closure of the majority of the Arab petroleum installations led to an increase of more than 23% over the preceding year, with production reaching 129.8 million tons, (2.5 million barrels per day).

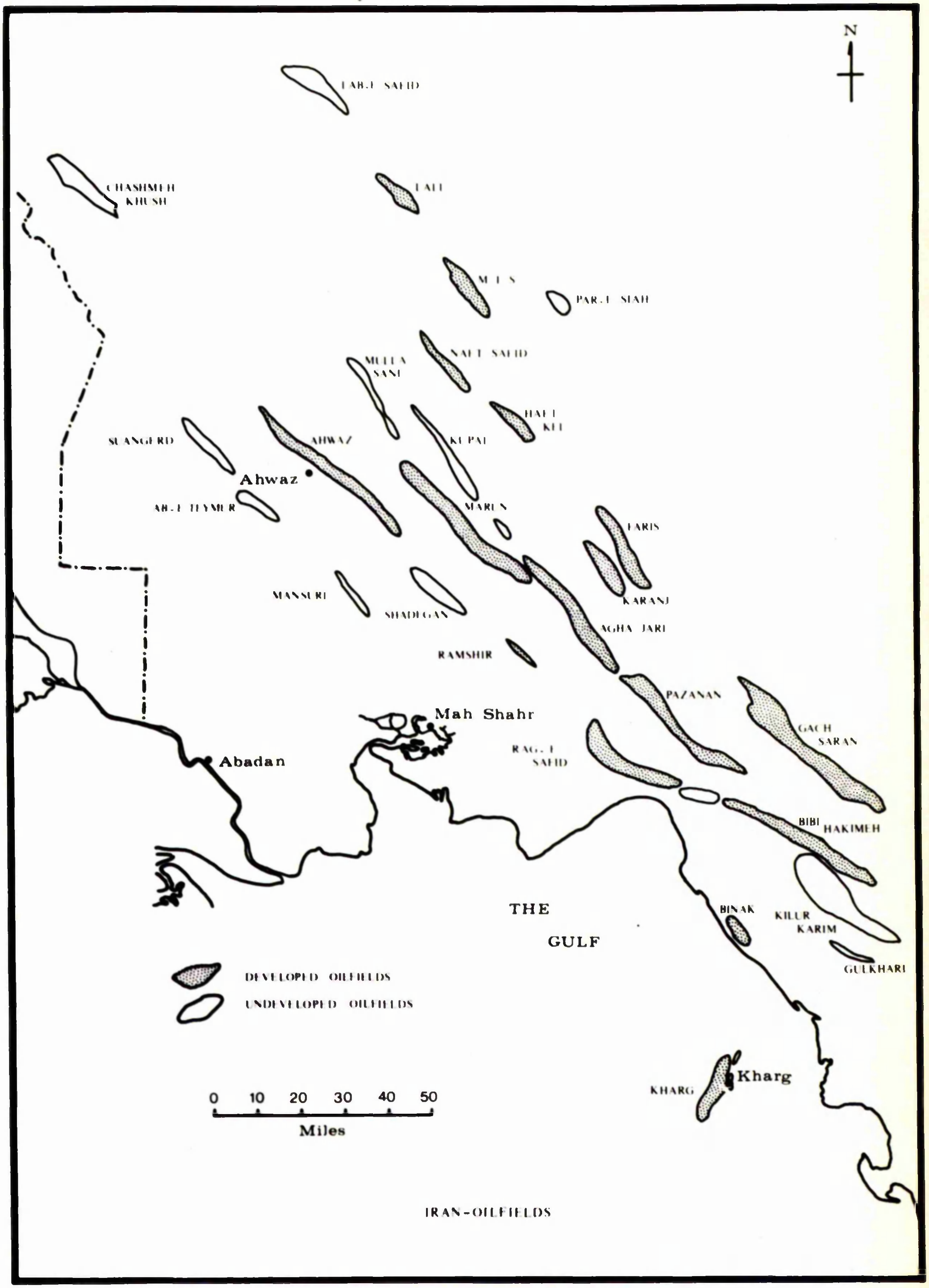

Fig. 2 - Location of the Consortium oil-fields.

Another factor which contributed to Iran's increase in output was the Nigerian Civil War, which co-incided with the Arab-Israeli War. Nigerian oil exports were kept down to only 50,000 barrels per day, compared to the 500,000 barrels per day which was exported in the first half of 1967. Thus in 1967, Kuwait's output of 129 million tons* was exceeded by that of Iran, and Iran became second only to Saudi Arabia as regards production of oil in the Middle East.

In 1968, Iran's production increased by 9.1% to 2,841,000 barrels per day, although in 1967 the growth was 23.2%, and even before that, the average growth rate between 1962 and 1967 was 14.5%. Iran's biggest single producer, Consortium, raised its output to 2,704,000 barrels per day in 1968, but the increase was only 9.3% as compared with the 1967 figure of 22.7%, which was, of course, a record. However, it was not expected that the 1968 figures would equal the 1967 ones for Consortium, as the conditions of 1967 were exceptional, with the closure of Iraqi pipelines and the Arab producers' embargo.

Production outside the Consortium area (offshore joint venture between NIOC and various foreign groups) remained around 137,000 barrels a day in 1968, but some estimates suggest that Iran may be producing as much as 700,000 barrels per day from non-Consortium fields by 1972, as a number of new offshore fields should be coming into production in 1971. These new fields include SIRIP's Nowruz, Iminoco's Rostam, and IPAC's Fereidoon.[11]

It is obvious that Iran was trying to regain its pre-1951 position as leader of the oil producers in the Middle East. There are several reasons for this desire, the main two being the development needs of Iran's 26 million people, and the

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* This figure includes Kuwait's share of oil from the Kuwait/Saudi Neutral Zone.

revenue requirements of a far-seeing economic development plan for 1968-73. In 1969, a registered growth of 18.7% confirmed Iran in its place as first oil producer in the Middle East. In that year, Saudi Arabia produced 160.25 million tons of oil (including that from the Neutral Zone), and Iran produced 168.1 million tons, which was 27.36% of the total Middle East production, and 7.83% of the world total. This placed Iran in fourth position in the world behind the United States, U.S.S.R. and Venezuela.

b. Saudi Arabia

In 1933, Standard California obtained the concession over the province of al-Hasa in the eastern section of Saudi Arabia. Late in September the same year, less than 4 months after the concession agreement was signed, the company's geologists arrived at the coast of al-Hasa, and began to survey the coastal region. The first promising structure was located at Jabal Dhahran (Dammam Dome), 5 miles inland from the coastal village of Dammam. After making a preliminary map of the Dammam Dome, geologists began to inspect the rest of the concession.[12]

In carrying out their work, however, the geologists faced a number of difficulties. The area was vaguely and inaccurately mapped, and the nature of the terrain made more accurate work difficult. In the immediate vicinity of the Gulf, shifting sand dunes are found, which break off near the shore into salt marshes and sandy beaches. From these dunes, extending for hundreds of miles inland, stretch rolling, unbroken hardsurfaced plains. The elevation of these plains ranges from 1,000 to 2,000 feet. As only about 4" of rain per year falls over the entire region, shallow wadis or dry water courses can easily accommodate it, and there is little or no vegetation. In summer, temperatures of 120°F in the shade, and 160°F in the sun are fairly common. However, in winter, temperatures of only 20°F have been recorded.[13] These conditions made working very difficult, because although air-conditioning is common nowadays, it was not so in the past.

Pioneer geologists in the area suffered not only from the severe nature of the region, but also from the lack of communication and transport, as there were no railways, highways, or even proper trails. To start with, prospectors depended largely on camel transportation for supplies, and the load limit for a good camel is about 400 lbs.

In 1936, well No.7 at Dhahran was started as a deep test, and large q uantities of oil from the Arab Zone (upper Jurassic limestone), were encountered after reaching a depth of 4,727 feet.[14]

In September 1939, at the outbreak of the second World War, the 8 completed wells of the Dhahran Field were producing on a small scale - about 10,000 barrels per day. The effect of the war on ARAMCO's operations was to gradually bring them to a halt. The number of American staff was reduced - 150 from 370 had left by the end of 1940, and another 100 had gone by mid-1942.

Apart from this, communication with America became difficult (the source of the supply of equipment), shipping was also adversely affected - there was a shortage of tankers, the market became inaccessible, and demand for crude oil in the Indian Ocean was negligible. Exporting was limited to Bahrain refinery. Exports from al-Khobar and Ras Tanura amounted to 510,000 tons in 1939, and this increased to 665,000 tons in 1940, but the next year it dropped to 565,000 tons.

All exploring, drilling or field engineering facilities were running down by mid-1943, but from then onwards a great change came over the Saudi scene. The United States government decided to undertake the quick wartime development of Arabia, as petroleum products were urgently needed, and there was unease about the extensive use of American oil reserves. Thus Saudi production, which came entirely from Dhahran (23 wells were producing), amounted to more than one million tons in 1944, and over 2.5 million tons in 1945.[15] By the end of that year, ARAMCO had discovered 4 fields, Dammam, Abu Hadriya, Abqaiq, and Qatif.

As a result of intensive development assisted by the United States, ARAMCO's position at the end of the War was very advantageous. It was in a position to supply any quantity of petroleum products whenever markets became available. However there was also a need for fairly heavy expenditure, and markets were limited, so the Caltex group encouraged any approaches to supply these. By the end of 1946, agreement in principle had been reached by the company and Standard Oil of New Jersey, and Socony Vacuum (now Mobil). In 1947, the latter two companies became partners in ARAMCO. As a result, ARAMCO's production rose from 7.9 million tons in 1946, to 26.1 million tons in 1950.[16]

At present ARAMCO has 12 producing fields, of which 3 are the main producers. These are Ghawar, which produced 1,519,564 barrels in 1968, and Abqaiq and Safaniya with outputs of 534,859, and 407,995 barrels respectively. The other producers are Abu Hadriya, Abu Sa'fah, Berri, Dammam, Fadhili, Khurais, Khursaniyah, Manifa, and Qatif. (See Fig. 3.) ARAMCO's heavy crude comes mainly from Safaniya, Manifa, and Khursaniyah, while light crude comes from the rest of the fields, but mostly from Abqaiq, which is 38 A.P.I.*

* The American Petroleum Institute - A.P.I. - gravity scale is an arbitrary method of expressing the specific gravity of oil. Crude oil prices are often based on A.P.I. gravity because, generally =

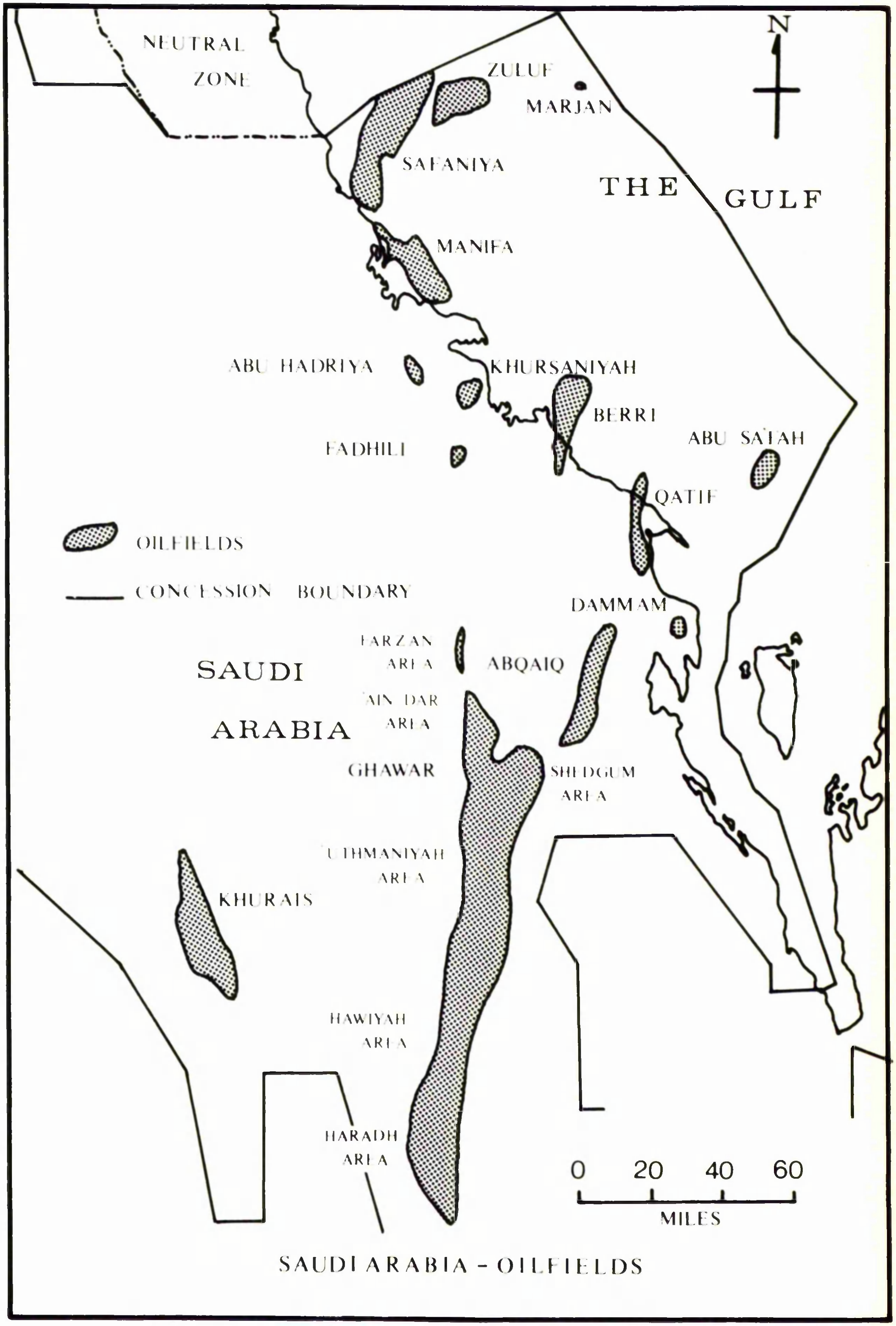

Fig. 3 - Location of ARAMCO oil-fields.

The following tables show crude oil production from different fields, and the number of producing wells, in various years.

Table 11 Average crude oil production from individual fields, in barrels per day - 1964-69

Field	1964	1965	1966	1967	1968	1969
Abqaiq	376477	409640	482026	515265	534859	633265
Abu Hadriya	24915	44990	60227	65426	81631	56925
Abu Sa'fah*	-	-	32247	40145	60350	65515
Berri	-	-	-	23178	19426	28322
Dammam	33488	25776	26131	23831	22622	22520
Fadhili	22421	19591	30990	40796	50690	31777
Ghawar total	733520	889948	961624	1244010	1519982	1488824
'Ain Dar	329589	343744	372127	387975	441430	442486
Fazran	23326	22408	18492	7569	6981	7122
Haradh	5244	36433	31260	23547	39643	12251
Hawiyah	-	-	48144	115359	127255	87617
Shedgum	113752	117619	129047	273075	449215	570088
'Uthmaniyah	261609	369743	362554	436485	455040	369259
Khurais	618	687	1000	1460	2387	14564
Khursaniya	106992	129549	130219	89312	31117	101576
Manifa	919	-	50999	54405	44936	40035
Qatif	28274	32467	72819	60496	54405	48551
Safaniya	388481	472222	544375	439239	407995	424776
Total	1716105	2024870	2392737	2597563	2829982	2992658

* Production from this field is shared by Saudi Arabia and Bahrain.

Source: See source of Table 12.

It is to be noted from the above table that in some fields the increase is regular, while in others it is not so. For example, the production of Ghawar and Abqaiq shows a constant increase, while production from Safaniya and Khursaniyah relates to the exhaustion of the fields, and the fluctuating demand for the oil from these fields, which both produce heavy crude oil, Safaniya's being 27° A.P.I., and Khursaniyah's being 30.° =

= speaking the lighter the crude (i.e. the lighter the A.P.I. gravity) the more light products it contains, and hence the higher its price ought to be. It is important to remember that the expression a "lower or heavier" gravity has opposite meanings in A.P.I. terms, i.e., as the specific gravity or density of an oil increases, the corresponding numerical A.P.I. value decreases, and vice versa, i.e., a light A.P.I. figure is 36°, and a heavy A.P.I. figure is 17°,

Table 12 Number of producing wells - 1964-69

Field	1964	1965	1966	1967	1968	1969
Abqaiq	60	64	64	64	64	78
Abu Hadriya	5	5	5	5	5	5
Abu Sa'fah	-	-	4	6	6	6
Berri	-	-	-	5	5	5
Dammam	25	21	21	19	19	20
Fadhili	2	2	2	2	2	2
Ghawar total	108	115	132	142	170	174
'Ain Dar	46	51	54	53	57	Not Available
Fazran	3	3	2	2	2	
Haradh	4	5	5	4	8	
Hawiyah	-	-	11	11	12	
Shadgum	15	15	15	24	41	
'Uthmaniyah	40	41	45	48	50	
Khurais	1	1	1	1	7	10
Khursaniyah	8	11	11	12	11	11
Manifa	5	5	5	5	4	2
Qatif	9	11	17	19	19	20
Safaniya	41	53	82	90	90	89
Total	264	288	344	370	403	423

The sources of the above tables are: The American Association of Petroleum Geologists' Bulletins, Oklahoma, U.S.A.:

Vol.49, Part II, July - December, 1965, pp.1314-15
Vol.50, Part II, July - December, 1966, p.1752
Vol.51, Part II, July - December, 1967, p.1635
Vol.52, August, 1968, p.1560
Vol.53, Part II, July - December, 1969, pp.1774-76
Vol.54 August, 1970, p.1535
The Oil and Gas Journal, December 28th, 1970.

Oil production in Saudi Arabia, as anywhere else in the Gulf, was greatly affected by the nationalisation of the Iranian oil industry. Saudi output increased from 25.9 million tons in 1950, to 36.9 million tons in 1951, and to 41 million tons in 1952. After this, production rose steadily until the Suez crisis of 1956. Both the embargo on oil shipments to Bahrain, Britain, France and other areas (November, 1956 - March, 1957), and the closure of the Suez Canal (October, 1956 - April, 1957), had an adverse effect on production of oil in Saudi Arabia in 1956 and 1957. The average crude oil production for October, 1956, was about 1 million b/d, and in January, 1957, it was only 665,000 b/d.

In July, 1957, however, after the canal had been re-opened, production rose to 1.2 million b/d, but a world-wide surplus in producing capacity, and a temporary recession in some major consuming countries stopped production from rising even further then. In 1959, the demand from the Eastern Hemisphere increased as the recession ended, and production once again rose. Since then annual increases in crude production have ranged from 6-8%. In 1965, for the first time, a daily production reached 2 million barrels, and in 1966 it increased 18% - to 2.4 million barrels.[17] It was in the latter year that Saudi Arabia's annual production of 119.4 million tons surpassed that of Kuwait, and it became the leading producer in the Middle East, and fourth in the world after the United States, U.S.S.R., and Venezuela.

In June, 1967, the Suez Canal was again closed due to the outbreak of war in the Middle East. This forced shipments of oil bound for Europe from the Gulf to go via the Cape. Transportation charges rose steeply as a shortage of tankers developed. For 5 days during the crisis, ARAMCO's production, refining, and terminal facilities were closed, and no tankers were loaded at Tapline's Sidon terminal for 14 weeks. For the first 5 months of 1967, crude oil production averaged 2.8 million b/d, (16%) above the production rate for 1966, and in June the daily production decreased to 1.6 million barrels.[18]

In 1969, Saudi Arabia produced oil at a rate of 2.99 million barrels a day, an increase of 5.7% over that of 1968. This increase was obtained despite the closing of the Tapline for 110 days following sabotage in the Israeli-occupied Gulan Heights on May 30th.[19] Saudi Arabia was leading the Middle East as a producer until 1969, when she lost her position to Iran. However, in terms of actual oil exports, Saudi Arabia still leads the field since Iran's domestic consumption now accounts for something like 200,000 barrels a day.

c. Kuwait

Kuwait Oil Company was established in 1934. The next year a geological survey which lasted for a year throughout the country was started by the Company. This survey was made easy by Kuwait's relief, which is relatively featureless, slightly undulating, sandy or gravelly desert, rising gently from the sea shore in the east to a height of about 900 feet above sea-level in the south-west corner. In 1936, the Company drilled its first exploratory well in the "Bahra" area, on the north shore of Kuwait Bay. This well was taken to a depth of 7,950 feet. Although it did not prove to be a commercial proposition, it was sufficiently encouraging for further investigation to be carried out. In 1938, another exploratory well was drilled on a promising structure in the "Burgan" area, 28 miles south of Kuwait Bay, and 14 miles from the Gulf coast. The results of the investigation at depths ranging from 3,672 to 3,692 feet were encouraging and indicated the presence of oil in commercial quantities. The well yielded oil at a rate of 4,343 barrels of 32.5° A.P.I. gravity per day.[20] Subsequently eight more productive wells were drilled in this area between 1938 and 1942. During World War II (1942-1945), operations were suspended by the Company, and the already completed wells were plugged, mainly due to the difficulties in transporting the produced oil to the world markets during hostilities. In addition to this, Kuwait Oil Company faced problems in obtaining equipment and manpower.[21] After the war, the Company resumed operations, and soon was producing 30,000 barrels per day from the Burgan Field. Although at present the Kuwait Oil Company has seven producing fields (Burgan, Magwa, Ahmadi, Roudhatain, Minagish, Sabiriya, and Umm Gudair), Burgan is still the largest in size and production. Three fields - Burgan, Magwa, and Ahmadi - are all interconnected and are collectively known as the Greater Burgan Field. Today it produces some 2.2 million barrels a day.[22] However, at the present time, production is distributed in the areas shown in Figs. 4 and 5.

Table 13 Status of producing wells in 1961, 1966, 1969

Fields	1961	%	1966	%	1969	%
Burgan	268	70.0	325	64.63	386	52.38
Magwa	44	11.7	66	13.12	189	25.64
Ahmadi	35	9.3	43	8.55		
Raudhatain	25	6.6	35	6.95	58	7.87
Minagish	4	1.1	16	3.18	23	3.12
Sabiriya	1	0.26	14	2.78	42	5.70
Umm Gudair	3	0.78	4	0.19	32	4.35
Bahra	1	0.26	-	-	7	0.94
Total	378	100.00	503	100.00	737	100.00

Sources: Kuwait Oil Company, Annual Review of Operations, 1961, 1966, and Oil and Gas Journal, December 28th, 1970, p.120.

The above figures show that Burgan retains its dominant position in the productivity of drilling new wells, although the rate of increase in a number of producing wells between 1961 and 1969 was lower than other fields. This should not detract from the fact that in 1969, 52.4% of the producing wells were in Burgan.

Over the years, the Kuwait Oil Company's exploration activities were not confined to the areas highlighted by the new discoveries described above, but extended over the whole area of its concession territories. The Company drilled several exploratory wells in different areas, such as Mutriba and Jirfan

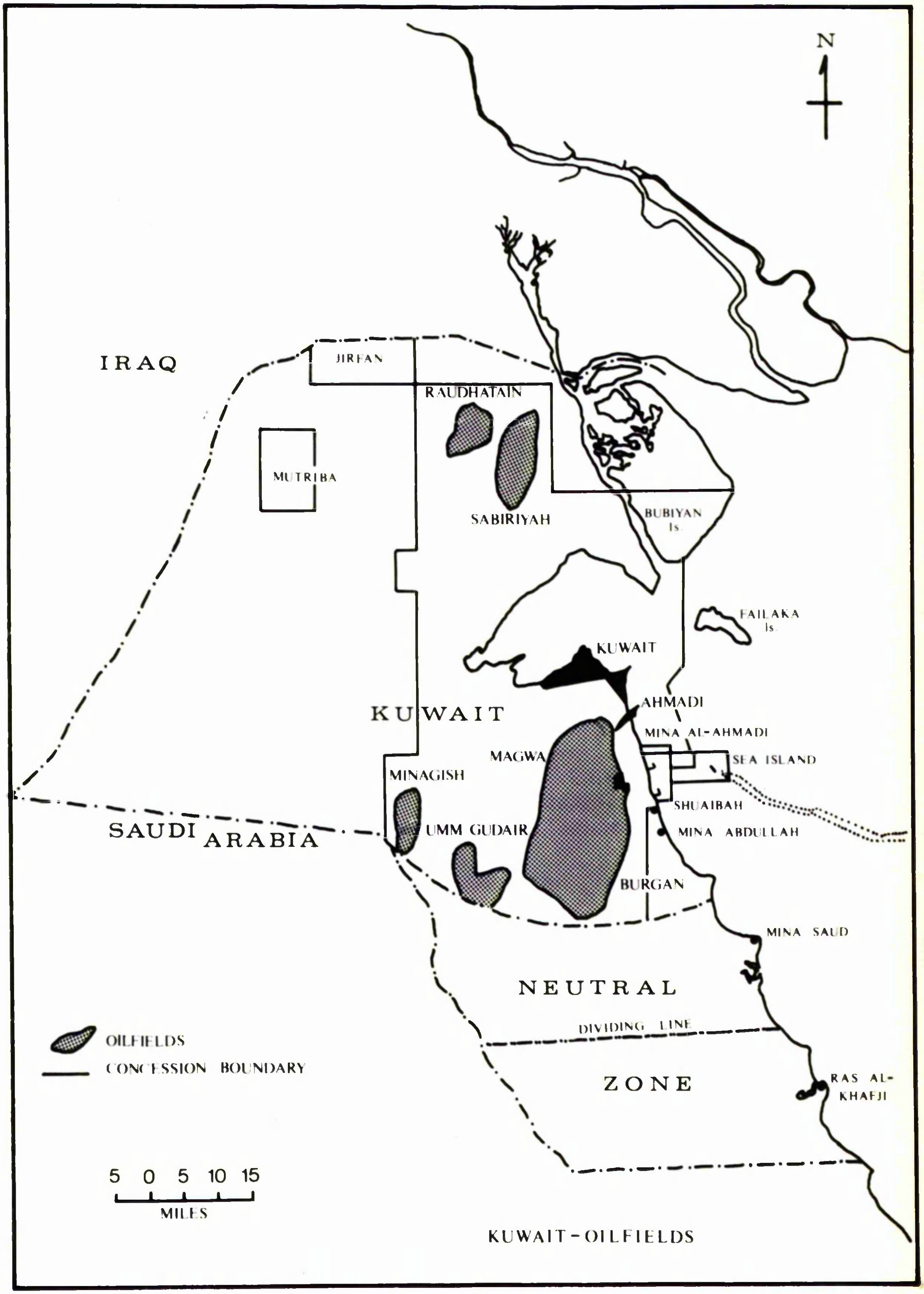

Fig. 4 - Location of Kuwait Oil Company oil-fields.

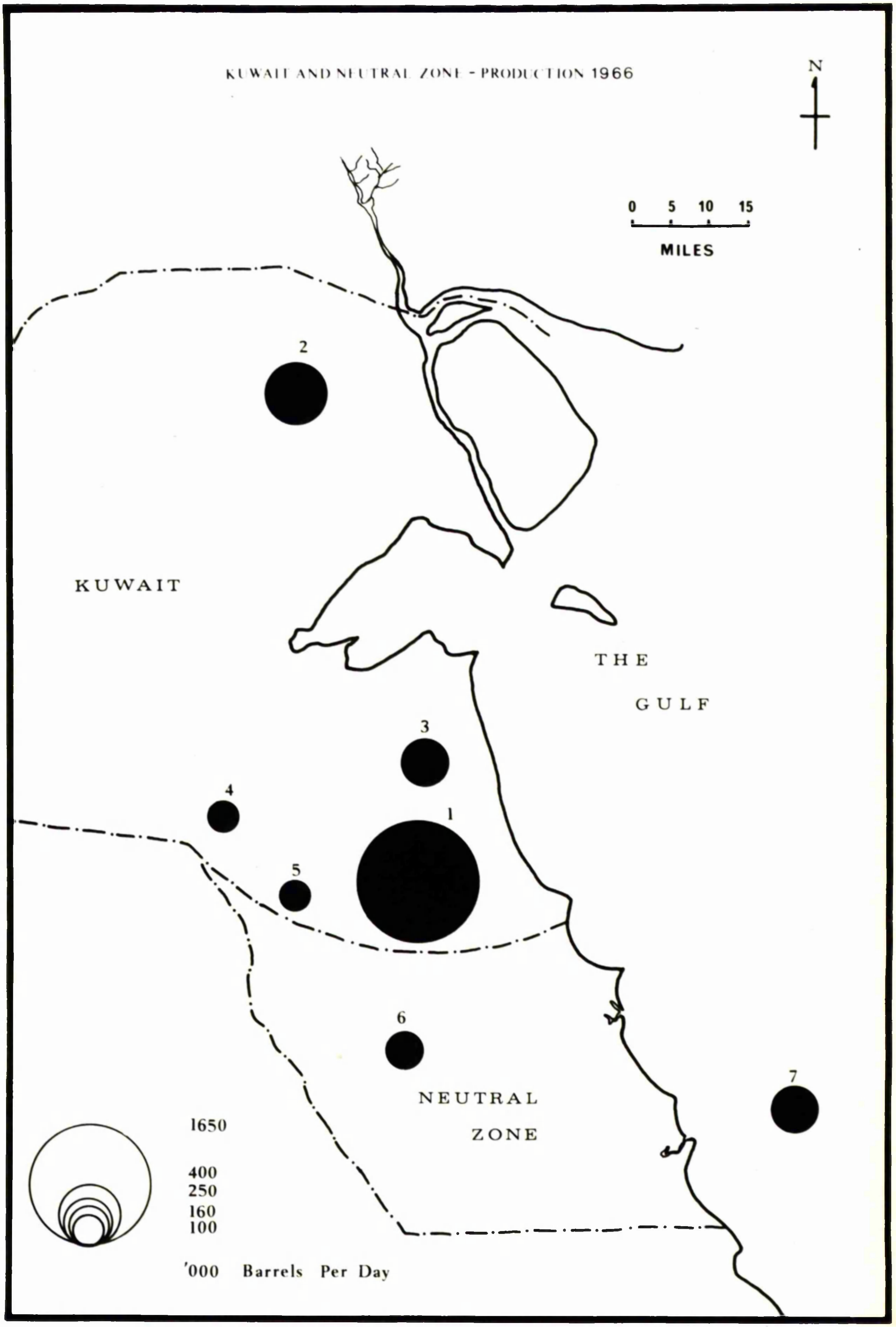

Fig. 5 - 1 - Burgan, 2 - Raudhatain, 3 - Magwa and Ahmadi, 4 - Minagish, 5 - Umm Gudair, 6 - Wafra and South Fawaris, 7 - Khafji.

in the south-west corner of the country, and Dibdibah in the west. All these tests carried out in the above areas proved unsuccessful and drilling was suspended.

Seismic surveys of Kuwait Bay and other offshore territorial waters included in the Company's concession rights took place in 1960, and the first attempt to explore these areas was in 1962. The motivation behind this was that on May 8th, 1962, the Kuwait Oil Company agreed with the government of Kuwait to relinquish 1,000 sq. km. of its offshore area in five year's time.[23] It is beyond doubt that the Company wished to establish before that date which areas were oil-less.

It is to be noted that although the quantity of oil produced in Kuwait brought the country up the ranks of world producers, until 1968, only three fields (Burgan, Magwa, and Ahmadi), from seven were developed to become large producers. The other four have great development potential. Apart from the developed area, there still remains a considerable area unexplored, particularly in the offshore. Thus any conclusion regarding distribution of oil in Kuwait must, therefore, be conjectural.

Table 14 Annual oil production by Kuwait Oil Company, and the percentage of increase or decrease - 1946-1969

Year	'000 tons	%age	Year	'000 tons	% age
1946	797	-	1958	69,117	22.4
1947	2,185	173.8	1959	68,437	-0.88
1948	6,291	168.8	1960	80,573	17.7
1949	12,183	93.2	1961	81,408	1.0
1950	17.018	39.8	1962	90,721	11.5
1951	27,783	63.0	1963	95,666	5.4
1952	37,042	33.4	1964	105,033	9.8
1953	42,603	15.1	1965	107,322	2.2
1954	46,969	10.4	1966	112,548	4.8
1955	53,894	14.7	1967	113,355	0.74
1956	54,117	0.35	1968	120,162	5.90
1957	56,375	4.04	1969	127,502	6.08

Source: Ministry of Finance and Industry in Kuwait

The war left the oil industry unscathed, and material and personnel became increasingly available, thus Europe's industrial reconstruction, leading to mounting fuel requirements, became the obvious market for Kuwait oil. Production, which was 797,350 tons in 1946, rose to 2 million tons in 1947, 6.2 million tons in 1948, 12 million in 1949, and 17 million in 1950.

As in the case of Saudi Arabia, the temporary cessation of Iranian oil production between 1951 and 1954 greatly affected the production of oil in Kuwait. In a world market which was clamouring for still more oil, the loss of 30 million tons a year from Iran was of great importance. However, the rapid development of other oil fields in the Gulf, especially in Kuwait (the Anglo-Iranian Oil Company has half of the shares of the concessionary company in Kuwait), was inevitable to compensate for the loss. Therefore, production in Kuwait increased from 17 million tons in 1950 to 46.9 million in 1954. However, this rate of increase did not last very long, due to the Suez Crisis of 1956 which caused a sharp drop in Kuwaiti production, and in fact the rate of increase in 1956 was only 0.35% over the previous year. Comparatively, the effects were worse on Kuwait than on Saudi Arabia, as the latter had an outlet on the Mediterranean. The situation caused a shortage of oil in Western Europe. This shortage stimulated the Kuwait Oil Company and other oil companies in the Middle East to increase their production immediately after the crisis in order to meet this European demand. Production by Kuwait Oil Company then increased from 54 million tons in 1956, to 69 million tons in 1958.

However, by 1959 an equilibrium between production and requirement of oil in the world market was reached, and this was followed by a consequent decrease of oil production in Kuwait in that year (1959) by 0.88%, compared with the previous year.

In 1967, a situation similar to that of Saudi Arabia occurred in Kuwait, the percentage increase in production of oil over 1966 was only 0.74%. Up to 1966, Kuwait was the leading producer in the Middle East, and fourth in the world. Since then the position has changed, and Kuwait is now third in the Middle East, and seventh in the world.

Reasons for the changes in the rate of production in Kuwait can be found in the type of oil produced there. It is slightly heavy - the gravity ranges from 30° to 32.5° A.P.I. Also, it contains about 2.5% of sulphur, which is a high percentage. Apart from political crises, these reasons make Kuwaiti oil less desirable than some others in the world market, thus explaining the difference in the rate of production.

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CHAPTER IV

A GEOGRAPHY OF INTERMEDIATE MOVEMENT OF OIL IN THE PRODUCING COUNTRIES

1. Inland Transport of oil (from wells to gas separators, from separators to storage tanks, and from storage tanks to terminals)

In considering the economic geography of any commodity, the location of supply and demand areas are major factors. In the case of the countries under discussion, these areas are widely separated, the prime area of demand being in Western Europe. Before oil assumes any value, therefore, it has to be transported. Pipelines carry the produced oil through its first stages until it reaches the terminals, where it is loaded into tankers to be carried to world markets. Crude oil passes through three stages between oil fields and export shipment: first from oil wells to gas separators where the crude oil is degassed, then the pumping to storage tanks, and finally to the terminals where it is loaded into oil tankers for export. In this chapter, only the main operating companies from these countries will be analysed, as production from any others is negligible in comparison.

Kuwait (Kuwait Oil Company)

Kuwait enjoys certain outstanding advantages insofar as inland transport is concerned, such as the flat and barren land surface, and the convenient placing of the oil fields near to the shore, reducing the length of pipeline needed for transportation. Further, all the oil tanks in Kuwait are located on one ridge which stands about 400 feet above sea-level, making the natural flow of oil from the tanks to the shipping points by force of gravity, without the application of any pumping methods. The exception to this is the movement of oil to the sea-island, where only 8,000 tons per hour are available by force of gravity, while the amount required is 15,000 tons. The result of this use of the force of gravity is the low cost of inland transport of oil.

Pipelines are one of several methods by which crude oil can be transported, and it is the only method used in Kuwait. In general, offshore pipelines are very expensive to lay. There are several reasons for this, among which are that there are few companies qualified to install offshore lines, and the pipe has to be imported,* and then coated to withstand corrosion on the sea-bed. During installation, provision has to be made for securing the line to the sea-bed, so that water movement does not affect it. All these considerations can raise the cost of a pipeline to as much as $7 million for a line measuring 8" x 30,000 feet. On land, however, the cost of a comparable line would be only $\frac{2}{3}$ of the offshore cost, because several factors are automatically eliminated, for example, weather conditions, and although the pipe still has to be wrapped and buried, the protection is not as essential as that which has to be given against salt water. The pipeline system in Kuwait has been enlarged steadily with the continual increase in production.

In all Kuwait Oil Company wells, oil flows to the surface by natural pressure, no pumping equipment is required at the well-head.** It is common practice to move the oil from the well-head by flowlines to plants which separate gas from the crude oil. These flowlines vary in diameter and length according to the productivity of the well and its location in relation to the gathering centres. (See Fig. 1.)

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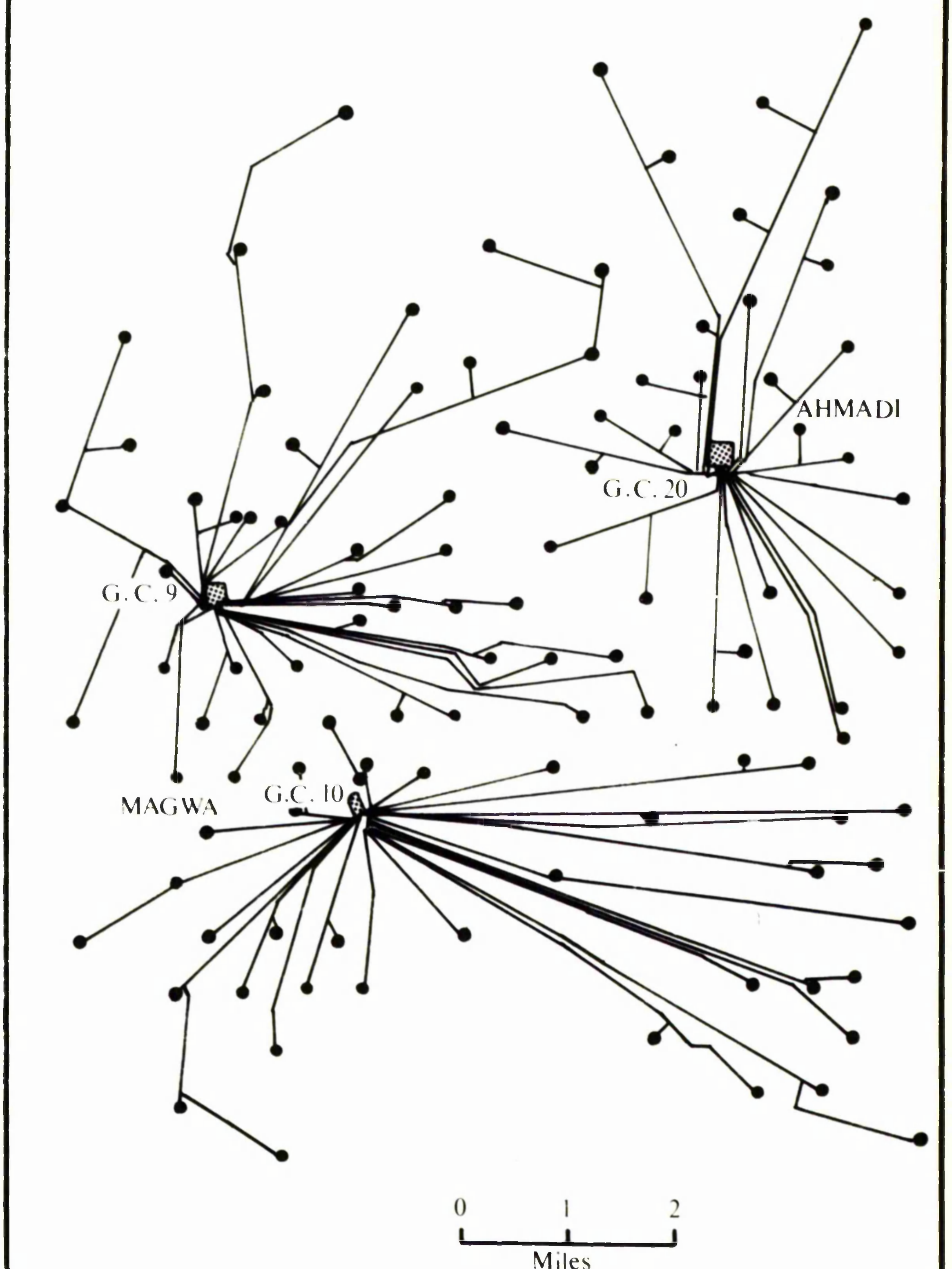
* Some countries, e.g. Iran, assemble the pipes themselves, but they still have to import the materials from other countries.

** The natural energy that makes Kuwait Oil Company wells free-flowing, includes both gas dissolved in oil, and water underlying the oil. Gas in the oil forces reservoir fluid to the surface, and water moves from below into the space vacated by produced gas and oil, which, in effect, helps displace the reservoir fluid. This is not only the case in Kuwait, but also in Saudi Arabia and Iran.



KUWAIT - OIL MOVEMENT VIA FLOWLINES

Fig. 1

The reservoir fluid that emerges from a well is not crude oil alone, but a mixture of oil and gas. This mixture is delivered to gathering centres where the oil is degassed. The production of any field or company is governed by the number and capacity of the gathering centres. Therefore, in order to increase its capacity for production, a company would have to increase the number and size of its gathering centres. Up to the end of 1967, Kuwait Oil Company had 18 gathering centres with a total capacity of 2.47 million barrels per day. Of these 18 gathering centres, 12 (Nos. 1-8 and 11-14) are situated in Burgan Field, 2 (Nos. 9 and 10) are near Magwa to serve both the Magwa and Ahmadi Fields. There are also 2 (Nos. 17 and 18) in Umm Gudair, one in the north (No.15) to serve the Raudhatain and Sabiriya fields, and another one (No. 16) at Minagish to serve Minagish's output. In 1968, after the construction of the sea-island terminal, larger amounts of oil were required, and in order to increase productivity new production facilities were installed. Among these were 7 new gathering centres. Two of these (Nos. 19 and 20) in north-east Burgan and north Ahmadi respectively, were commissioned and completed in the same year. Gathering centres No.21 at Burgan, and 22 near Ahmadi were completed in 1969. Also at the time gathering centres Nos. 23, 24 and 25 in the north of Kuwait were under construction, and were due for completion at the beginning of 1970. (See Fig. 2.) These will have a nominal total capacity of 400,000 barrels per day.[1] The Table below shows the nominal capacity of each gathering centre in the different fields.

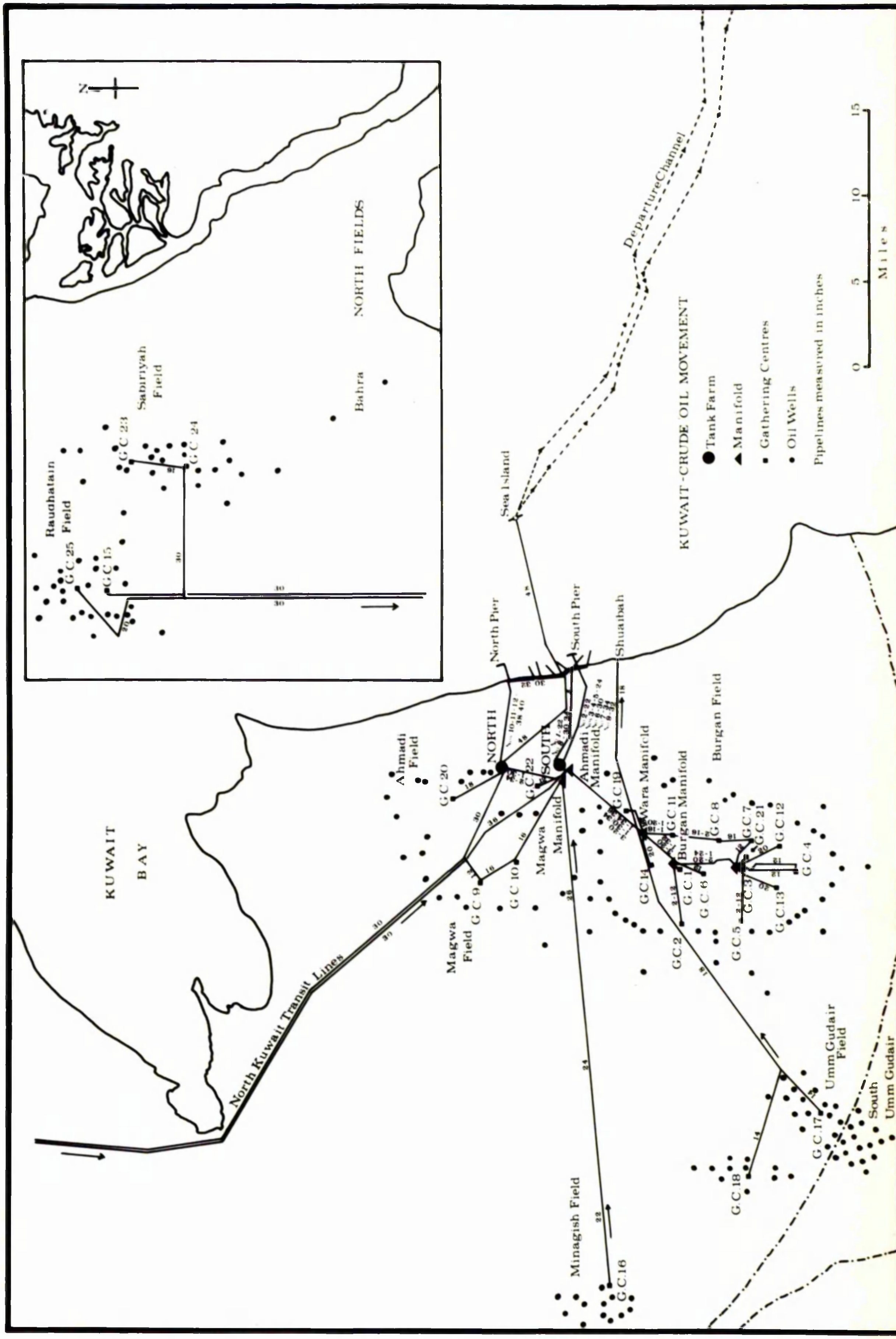

KUWAIT-CRUDE OIL MOVEMENT
Tank Farm
Manifold
Gathering Centres
Oil Wells
Pipelines measured in inches
Miles
0
5
10
15
KUWAIT
BAY
North Kuwait Transit Lines
Magwa Field
Ahmadi Field
NORTH
SOUTH
Magwa Manifold
Ahmadi Manifold
Wara Manifold
Burgan Manifold
Burgan Field
North Pier
South Pier
Shuaibah
Sea Island
Departure Channel
Minagish Field
Umm Gudair Field
South Umm Gudair
G C 16
G C 17
G C 18
G C 20
G C 22
G C 9
G C 10
G C 19
G C 14
G C 2
G C 1
G C 6
G C 11
G C 8
G C 5
G C 3
G C 13
G C 7
G C 21
G C 12
G C 4
Raudhatain Field
Sabriyah Field
Bahra
NORTH FIELDS
G C 25
G C 15
G C 23
G C 24
N

Fig. 2

Table 1 The capacity of gathering centres at each field

Field	No. of G.C.	Daily Capacity ('000 barrels)
S. Field		
	1	180
	2	155
	3	145
	4	140
	5	145
	6	140
Burgan	7	140
	8	180
	11	190
	12	190
	13	190
	14	200
	19	100
	21	100
Total	14	2,195
Magwa	9	145
	10	145
Total	2	290
Ahmadi	20	100
	22	100
Total	2	200
Umm Gudair	17	65
	18	35
Total	2	100
Minagish	16	85
Total	1	85
N. Fields		
Raudhatain	15	380
	25	100
Total	2	480
Sabiriya	23	150
	24	150
Total	2	300

Source: Data received from Kuwait Oil Company in Kuwait, by private communication. (April, 1970)

Plate 6 - A general view of Gathering Centre No. 14 in Burgan Field, Kuwait.

Of course, the number of wells connected to centres is variable, and data given at a point of time should be regarded in that context. At the same time, it must be realised that the capacities of gathering centres are nominal figures, being a balance between separators and well capacities. Actual throughput can and does vary quite considerably.

After passing through the gathering centres, crude oil goes through several manifolds, from where it is collected and moved to tank farms. The following table and Fig. 2 show the pipeline systems and their lengths in Kuwait.

Table 2 Crude oil pipelines system

G.C.4	12" - 17,436'	to G.C. 3 Manifold
	12" - 18,593'	" " "
G.C.12	20" - 14,142'	" " "
G.C.13	20" - 12,900'	" " "
G.C. 5	12" - 15,816'	" " "
	12" - 161,331'	" " "
G.C.21	12" - 3,168'	" " "
G.C. 7	12" - 9,948'	" " "
	16" - 9,489'	to G.C. 8 Manifold
G.C. 6	12" - 8,513'	to Burgan Manifold
G.C. 3	2 x 20" - 19,774'	" "
	24" - 19,548'	" " "
G.C. 2	12" - 17,955'	" " "
	12" - 18,292	" " "
G.C. 8	16" & 20" - 14,221' & 517'	to G.C.11 Manifold
	16" - 14,738'	to G.C.11 Manifold
G.C.11	16" - 10,200	to Wara Manifold
	20" - 10,173'	" " "
Burgan Manifold to Wara Manifold		
	3 x 20" - 15,558'	
	32" - 15,563'	
G.C.14	20" - 11,625'	to Wara Manifold
G.C.19	16" - 5,900'	" " "
Wara Manifold to Ahmadi Manifold		
	20" - 13,459' & 22" - 11,429'	
	2 x 20" - 24,888'	
	30" - 9,260' & 34" - 15,633'	
	34" - 19,894' & 36" - 5,058'	
Ahmadi Manifold to Magwa Manifold		
	2 x 20" - 5,115'	
	1 - 22" - 5,115'	
	1 - 34" - 5,115'	

Table 2 (cont'd)

G.C.16 to Magwa Manifold

	22" -	54950'	
	24" -	51250'	
	26" -	51700'	
G.C.17	14" -	18500'	
G.C.18	14" -	33500'	

Transit Line

G.C. 17 & 18	14"-18"-135321'		to Shuaiba Refinery

North Tank Farm to Magwa Manifold

	1 x 30" - 8546', 1 x 32" - 1102', 1 x 34" - 10598'		
	2 x 34" - 21577'		
G.C.10	16" -	32312'	to Magwa Manifold
G.C.22	12" -	7498'	" " "
G.C. 9	16" -	14168'	to G.C.10 Manifold
G.C.20	18" -	19100'	to North Tank Farm
G.C.15	30" -	(303312' + 29594') 332906' to North Tank Farm	
G.C.23	16" -	23900'	to G.C.24
G.C.25	20" -	43500'	to Tie in Point
G.C.24	30" -	34100'	" " " "

Tie in Point to Magwa Manifold

	30" - 270, 481,	36" - 40100'

South Tank Farm Gravity Lines to Submarine Manifold

No.1	22" -	28945' K.L.D.	
No.8	30" -	7320',	34" - 2029'
No.2	22" -	27890'	
Nos. 3, 4, 5	24" -	27890'	
No.6	30" -	27890'	
No.7	34" -	27890'	
No.9	32" -	27890'	

Shore Feeder Lines Between Piers

	30" -	8085',	32" - 4512'
To D Berth	30" -	4833'	
To E Berth	30" -	10058'	
To H Berth	30" -	11435'	

24" Laterals to Switchgate Manifold - 2427'

North Tank Farm Gravity Lines to North Pier

Nos. 10, 11 & 12 3 x 38" - 8620', 3 x 40" - 15954'

Source: Data received from Kuwait Oil Company in London - December, 1970.

As mentioned above, after being degassed in gathering centres, crude oil is pumped to South and North Storage Tank Farms, which are situated on the Ahmadi Ridge.* Construction of crude oil storage installations at the South Tank Farm commenced in 1946, and on the 23rd of June that year, Tank No.1 was completed. During that same year, Kuwait started shipping out crude oil for export. The increased output of crude oil demanded a parallel increase in the capacity and number of tanks in successive years. The storage capacity was raised from 558,000 barrels in 1946, to 3.357 million barrels in 1952, and to 5.383 million barrels in 1958.

An economic study has shown that a big company with large production would find it less economical to build 4 storage tanks of 250,000 barrels, or 2 tanks of 500,000 barrels, than 1 tank of 1,000,000 barrels. The saving is nearly $\frac{1}{3}$, as a 1,000,000 barrel tank costs about $1,100,000 and a 500,000 barrel tank costs about $750,000.[2]

Although submarine tanks have only recently come into operation, several advantages and disadvantages have come to light already. For example, if a field is a long way from the shore, pipeline costs are eliminated. Another advantage is that they are unaffected by weather conditions. However, problems have arisen regarding dirt and sand,and also water, becoming mixed with the oil.

The discovery of new fields in the northern areas of the country caused another increase in the output, making it necessary in 1959 to build

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* Ahmadi Ridge rises to approximately 400 feet above sea level, and separates the Burgan plains from the Gulf, defining the trend of the coastline. The top of the ridge is about 6 miles from the sea, sloping down gently to the east towards the Gulf, and the west towards the Burgan plains.

a new storage tank farm (North Tank Farm), about 14 miles north of the South Farm. The main reason for the construction of the North Farm was to store the output of the north fields, and to serve the North Pier, which was commissioned in the same year. Although there are more tanks in the South Tank Farm than the North one, the total capacity of the northern farm is greater. This is because the capacity of the tanks at the North Farm ranges from 200,000 to 600,000 barrels, whereas the ones at the South Farm hold only 100,000 to 200,000 barrels. The farms are linked by pipelines, enabling oil to be pumped from the North Farm to the South, or vice versa. However, in 1969, the number of crude oil tanks in both South and North Farms totalled 53, of which 33 are situated in the South Farm, and the rest in the northern one. The capacities of the storage tanks in the North and South Farms are explained in the Table below.

Table 3 The number of tanks, their capacities, and the periods in which they were commissioned

	No. of Tanks	Capacity of 1 tank (bls)	Total Capacity (bls)	Period in which commissioned
South	1 - 6 (6)	139,500	837,000	23/6/46 - 23/11/47
Tank	9 - 30 (22)	168,000	3,696,000	18/2/49 - 13/3/55
Farm	31 - 35 (5)	210,000	1,050,000	13/3/55 - 5/3/58
Total	33		5,581,000	
North	36 (1)	210,000	210,000	10/5/59
Tank	37 - 47 (11)	262,000	2,882,000	17/5/59 - 24/10/59
Farm	48 - 50 (3)	262,000	788,400	25/5/60 - 10/6/60
	51 - 55 (5)	600,000	3,000,000	21/10/69 - 21/12/69
Total	20		6,880,400	

Source: Data received from Kuwait Oil Company in Kuwait, during field work, April, 1970.

Both tank farms were built on the Ahmadi ridge in order to employ the force of gravity in moving the oil to the terminals. Another advantage in the positioning of the farms is that the ridge is not far from the oil fields, most of them being within a radius of 10 - 20 miles, and a third is that the ridge itself is only about 6 miles from the shore. There are, however, two exceptions to this, which are nearly 77 miles distant. Normally, tanks are situated by the terminals, and at a great distance from the fields, thus necessitating the construction and operation of long pipelines between them. Oil has to be pumped along these lines, making the whole operation more costly. This is evidenced by the Iraqi pipelines from Kirkuk to the Mediterranean, which range from 532 - 555 miles in length. From this, it is plain that Kuwaiti oil can be transported more conveniently and cheaply than that of other oil producing countries.

From the Tank Farms to the Terminals:

There is a choice of four routes for crude destined for export, and all four can be utilised at one time. One route is via 5 submarine loading lines of 12" diameter. These are connected to the South Tank Farm, and are not used at present. The South Tank Farm is also connected to the South Pier by 7 pipelines ranging from 22" - 34" in diameter. A one mile long, 48" diameter spur line connects the South Tank lines to the Sea Island loading system at the crude oil pumphouse. The North Tank Farm is connected to the North Pier by three 38" - 40" diameter pipelines, and to the Sea Island by a 48" pipeline. (See Fig. 2). The latter is buried in the sea-bed from the shore to the sea island for safety precautions. A powerful crude oil pumping unit is situated on shore on the 48" pipeline route to boost transmission.

By virtue of the elevated position of the Tank Farm (about 400 feet above sea level), crude oil flows down by gravity, and loading rates may reach 7,000 tons per hour at the South Pier, and 12,000 tons per hour at the North Pier. The gravity flow rate to the sea-island is in excess of 8,000 tons per hour, and by using the crude oil pumping unit, rates of over 15,000 tons per hour can be achieved.

A complex system of manifolds leads to extreme flexibility so that any tank at either farm can be available to any berth on either pier and the sea island. All oil entering the farms can be controlled, and all crude delivered to both of the piers, and the sea island can be segregated and controlled from the Central Control Room at Ahmadi.[3]

Saudi Arabia (ARAMCO)

Inland transportation of oil in Saudi Arabia differs slightly from that in Kuwait. Before reaching the terminal, crude oil undergoes various processes. From wells it is moved to gas separator plants (called gathering centres in Kuwait), to stabilizers where the oil is sweetened and sent on to the Tank Farms. Some tank farms are located close to the gas separator plants, and some are many miles away. Oil from tanks near the gas separators is moved to either the terminal at Ras Tanura, or to other destinations, such as Bahrain, or Sidon on the Mediterranean. On the following pages, the different stages through which crude oil passes will be discussed.

Natural gas pressure in the fields forces oil and gas to the surface and removes the necessity for any pumping systems at the well-head.

In off-shore fields, it is common practice to move the oil from the well-head by flow lines to a plant which separates gas from crude oil. These flowlines vary from 4 - 10 inches in diameter, depending on the producing capacity of the well, and the longest are about 11 miles long.

In contrast to Kuwait Oil Company, ARAMCO has offshore fields, and to bring oil from these, the usual method is to run a large diameter trunk-line from an onshore gas-oil separator through the middle of the offshore field, where smaller flowlines branch off to individual wells. In 1968, ARAMCO installed its first offshore separator plant in the Safaniya field, about 30 miles from land.

As in Kuwait, the reservoir fluid that emerges from a well is not crude oil alone, but a mixture of oil and gas. This mixture is delivered to a series of vessels, or traps in a gas-oil separator plant, where the two are physically separated. In the Abqaiq field, and in Ain Dar and Shedgum of the Ghawar field, gas that comes from the first stage separator vessels is compressed and reinjected into the reservoir. The number of gas separator plants in all ARAMCO's fields reached 21 in 1968, and a total of 2,829,000 barrels per day was being obtained in the same year.

After being degassed, crude oil is pumped to stabilizers for sweetening, a process not used in Kuwait, where it is unnecessary. Crude oil leaving all separators with the exception of Safaniya, is sour crude, that is, it contains toxic hydrogen sulphide (H_2S). Some crude can be moved by pipeline and used as refinery feed, but it is undesirable for tanker transport. Because the major portion of crude from Saudi Arabia is shipped by tankers to world markets, sour crude must be sweetened or stabilized prior to shipment.

The Abqaiq stabilizer plant, which has a capacity of 1,690,000 b/d, sweetens the majority of the crude oil produced in the Abqaiq and Ghawar fields. Stabilization is accomplished by the relatively simple process of boiling off the hydrogen sulphide, which ranges between 300-700 parts per million in sour crude. The sweetened crude oil is afterwards delivered to Abqaiq Tank Farm No.2.

A second stabilizer, with a capacity of 150,000 b/d, is located at Abu Hadriya to treat crude oil from the Abu Hadriya and Fadhili gas separators, and the sweetened crude is pumped directly into the pipeline to be carried to the Qaisumah Tank Farm.

Some crude can also be sent to Ras Tanura for refinery feed stock, or for stabilization in the stabilizers in the refinery there. This plant has a capacity of 395,000 b/d. Alternatively, the sour crude can be delivered by pipeline to the Bahrain Petroleum Company (BAPCO).[4]

The following tables show the dimensions of the crude pipelines and capacities of the Tank Farms.

Table 4 The main crude oil pipelines and their dimensions

Pipeline		Size in inches	Length in miles
From gas separators to stabilizer and to storage tanks			
Ain Dar	- Abqaiq No.1	20-22-24	28.3
" "	- " No.2	24-26-28	28.4
Uthmaniyah	- " No.1	18-20-24-30-31	127.8
"	- " No.2	34-36	32.8
Khurais	- Ain Dar No.1	16-18	86.2
Fadhili	- Abu Hadriya*	12-14	25.5
From Safaniya to Ras Tanura Tank Farm**			
Safaniya	- Ras Tanura No.1	22	130.6
"	- " " No.2	30-32	130.6
"	- " " No.3	36-38-40-42	130.6
"	- " " No.4	40-42	40.3

cont'd

Table 4 (cont'd)

Pipeline	Size in inches	Length in miles
From Abqaiq Tank Farm Nos. 1 & 2 to Qatif Junction and to Dhahran Tank Farm		
Abqaiq - Qatif Junction No.1	30	44.7
" - " " No.2	20-22	43.8
" - " " No.3	30-32	43.6
" - " " No.4	40-42	42.6
" - Dhahran No.1	12-14	39.0
" - " No.2	14	39.6
From Qatif Junction to Ras Tanura and Qaisumah		
Qatif Junction - Ras Tanura No.1	20-22	17.4
" " - " " No.3	22	14.4
" " - " " No.5	34-36	17.1
" " - " " No.6	40-42	17.1
" " - Qaisumah	30-31	269.3
From Dhahran Tank Farm No.2 to Bahrain		
Arabia - Bahrain No.1	12	33.5
" - " No.2	12-14	33.4
From Ras Tanura Tank Farm to Ras Tanura Terminal		
Ras Tanura Terminal Line No.10	20-22	6.1
" " " " No.12	30	6.1
" " " " No.16	34-36	5.6
" " " " No.18	40-42	5.5

* Output from Fadhili and Abu Hadriya can take two routes, either to Qaisumah Tank Farm or to Qatif Junction.

** Apart from Safaniya production, output from Manifa, Khursaniyah and Berri fields is transported via these pipelines first to Ras Tanura stabilizer plant, and then to Ras Tanura Tank Farm.

Source: See Table 5.

Table 5 The main crude oil storage tanks, their working capacities, and number of tanks in each farm

Tank Farm	No. of Tanks	Capacity in barrels
Abqaiq Tank Farm No.1	5	730,000
" " " No.2	8	1,200,000
Dhahran Tank Farm No.2	5	864,000
Qaisumah Tank Farm *	7	1,170,000
Ras Tanura Tank Farm	95	16,000,000
Total	120	19,964,000

* The Qaisumah Tank Farm is about 291 miles from Dhahran, and it is the most distant of ARAMCO's oil installations. From there crude oil is fed to the Tapline to be transported to Sidon, the Lebanese port at the Mediterranean.

Source: Data given in the above two tables received from ARAMCO in Saudi Arabia, March, 1970.

In Kuwait the transportation of oil is a fairly simple process, as crude has to travel from the separators to only two Tank Farms, 14 miles apart, and the most distant field is about 77 miles. However, in Saudi Arabia, transportation is much more of a problem. There are several Tank Farms, and some of them are very widely separated, for instance, Qaisumah and Qatif Junction (from where the farm receives some of its oil) are about 269 miles apart. These great distances make it necessary for the oil to be pumped to move it, while this is not necessary in Kuwait. Thus the cost of moving oil in Saudi Arabia is much more than in Kuwait.

From all gas separators the oil goes to stabilizers,* from where it goes by pipeline to various tank farms, and then there is a choice of three outlets. The

* This excludes Safaniya's output, which is sweet, and therefore does not require stabilizing. It passes straight to the Tank Farm at Ras Tanura from the gas-oil separator plant.

Plate 7 - Gas being burned after separation at a production unit at Ahwaz, Iran.

first is to Ras Tanura where the oil is loaded onto tankers. The second is from Dhahran Tank Farm to Bahrain, and the third is from Qaisumah Tank Farm via the Tapline to Sidon at the Mediterranean. To give an indication of the volume of oil which follows these routes, the year 1969 is taken as an example. In that year 101,794,000 tons of oil passed through Ras Tanura to be loaded onto tankers; 7,728,000 tons went through Dhahran to Bahrain; and 16,768,000 tons passed through the Tapline to Sidon.[5]

<u>Iran (Iranian Oil Operating Companies)</u>

As is the case in both Kuwait and Saudi Arabia, oil in Iran comes to the surface by natural pressure, and no pumping equipment is needed. The oil is moved by pipelines to plants* where gas is separated from the crude oil. These pipelines, commonly called flowlines, average from 6-8 inches in diameter, although they can vary according to the productivity of the well. An 8 inch pipeline can cope with a production of about 40,000 barrels a day.

Pipeline installation in Iran is more expensive than in other oil-producing countries around the Gulf, with the possible exception of Iraq. There are several reasons for this, the main ones being that the majority of the oil fields are situated in mountainous territory, and good access roads have to be constructed. Also the pipelines have to be built up and down the mountains in these areas, which requires a greater length of pipe, and more complicated construction.

The following Table shows the situation of the fields with regard to their production units, and number of wells connected to each.

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* These are called production units in Iran, while in Saudi Arabia they are gas separator plants, and gathering centres in Kuwait.

Table 6 The number and capacities of production units and number of wells connected to each in December 1969

Fields	Production Units	Capacity in b/d	No. of wells connected
Lali	1 well-head separator	2,000	1
M.I.S.	1) Well- 2) head 3) separat- 4) ors*	26,000	20
Naft Safid	No.1	33,000	14
Haft Kel	No.1	40,000	11
	No.2	60,000	
Marun	No.1	60,000	3
	No.2	265,000	9
	No.3	300,000	12
Agha Jari	No.1	310,000	12
	No.2	235,000	9
	No.3	235,000	12
	No.4	240,000	7**
	No.5	210,000	6***
Ramshir	No.1	20,000	2
Rag-e Safid	No.1	50,000	3
Pazanan	No.1	70,000	2
Gach Saran	No.1	195,000	9
	No.2	220,000	8
	No.3	406,000	8
Bibi Hakimeh	No.1	230,000	10
	No.2	260,000	6
Binak	No.1	50,000	1
Kharg	No.1	23,000	4
Ahwaz	No.1	82,000	10
	No.2	190,000	11
14	23	3,812,000	190

* The process here is only partial separation.

** The figure includes one well from Karanj Field, and one well from Faris Field.

*** The figure includes one well from Marun Field.

Source: Data received from Consortium at M.I.S., Iran, December, 1969.

In Iran the system for channeling the oil after degassing it is not the same as those in Kuwait and Saudi Arabia, where crude is moved directly from all the fields to the tank farms. Degassed crude oil from the

Iranian fields is divided into two sections and moved accordingly. Oil from Lali, M.I.S., Naft Safid, Haft Kel, Ahwaz, Rag-e Safid and Marun (from production unit No.1 only) is taken to Abadan refinery, while the output from Marun (production unit Nos. 2 & 3), Agha Jari, Ramshir, Faris, Karanj, Pazanan, Gach Saran, Bibi Hakimeh, Binak and Kharg fields is moved to Kharg Island. (See Fig. 3.) These arrangements, are however, flexible.

Abadan refinery received about 18.2 million tons of crude oil from its fields in 1964, in 1966 the amount was 18.6 million, and in 1968 it rose to 20 million tons. Kharg Island received about 61.8 million tons of crude oil in 1964, and 79 million in 1966, while in 1968, the figure was 108.8 million tons.[6]

2. Shipping Points

Water depth in the Gulf is of very great importance, particularly in view of the ever increasing size of tankers. Without deep water, the producing country faces great difficulty in shipping oil destined for export. An example of this is Iraq, the northern oil fields are located a long way from deep water, thus the produced oil has to be transported a great distance to the Mediterranean.

As a result of the geological character of the Gulf, and particularly because of the considerable volume of sedimentation from the Tigris-Euphrates, water is not very deep anywhere in the Gulf and it is particularly shallow at the head. Elsewhere the water is generally deeper on the eastern side than the western.

Depths along the shore of the Gulf vary from one area to another, and this is reflected in the position of the 10 fathom submarine contour line (60 feet)

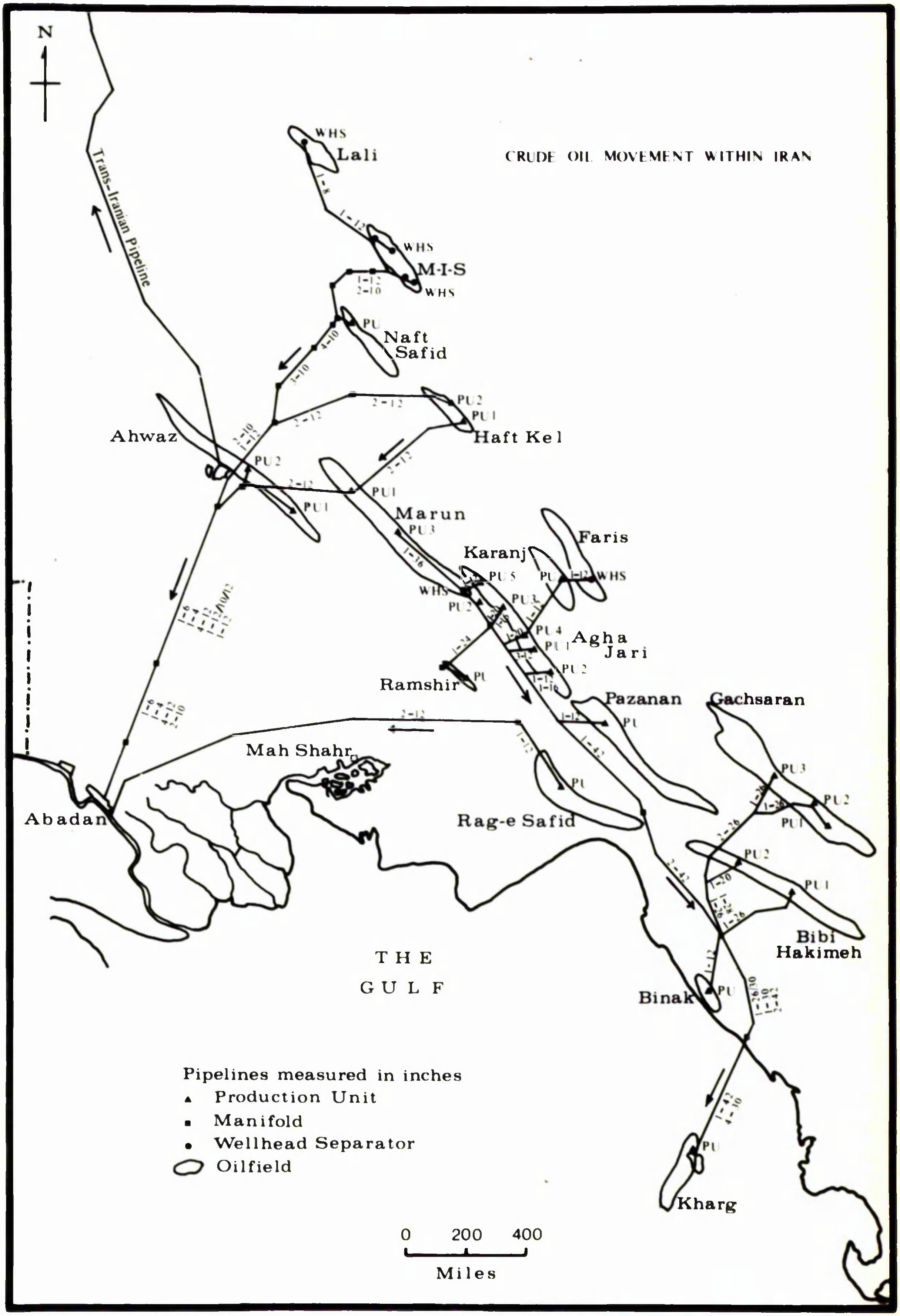

Fig. 3 - Crude oil movement within Iran - movement of oil from Production Units to Abadan Refinery and to Kharg Terminal.

in relation to the shoreline. It is clear from Fig.4 that the 10 fathom submarine contour line follows the coastline fairly closely on the Iranian side of the Gulf, and at no time is it very far from the shore, particularly at Kharg where the water is very deep. In some places the contour lines merge. At the top of the Gulf the water is very shallow. There even the 5 fathom line lies about 11 nautical miles south of Failaka Island. However, off Mina al-Ahmadi in Kuwait, the 10 fathom line is about 1 mile from the shore. This situation lasts only for a few miles, though, and all down the rest of the coast, the coastal waters are again shallow, even at Ras Tanura in Saudi Arabia. Thus for ports situated in shallow water areas dredging is necessary to keep them operational. There is a tremendous variation in the cost of dredging, depending on whether it is hard or soft material on the sea-bed. A large portion of the Gulf, especially towards the south, is underlain by hard limestone, which is extremely expensive to dredge. In areas where less difficult material underlies the waters of the Gulf, dredging may cost as much as 72 to 96 cents per cubic yard. The major cost appears to be in getting the equipment to the site, as it may have to be brought from Europe. The only way to reduce this expense is to time the need for the plant to co-incide with other work in the Gulf, thus spreading the costs of transport to the area.

There are three types of loading system in common use today. These are, firstly, <u>single-buoy moorings,</u> which represent a very elementary system of loading, more commonly used by companies with small production, which does not justify the building of jetties. These buoys are connected to the sea-bed by about 8 anchor chains, and the submarine loading line is run along the sea-bed to a manifold, from where it is connected to rubber hoses, and then to the buoy. When a tanker arrives, it is positioned and then anchored. The

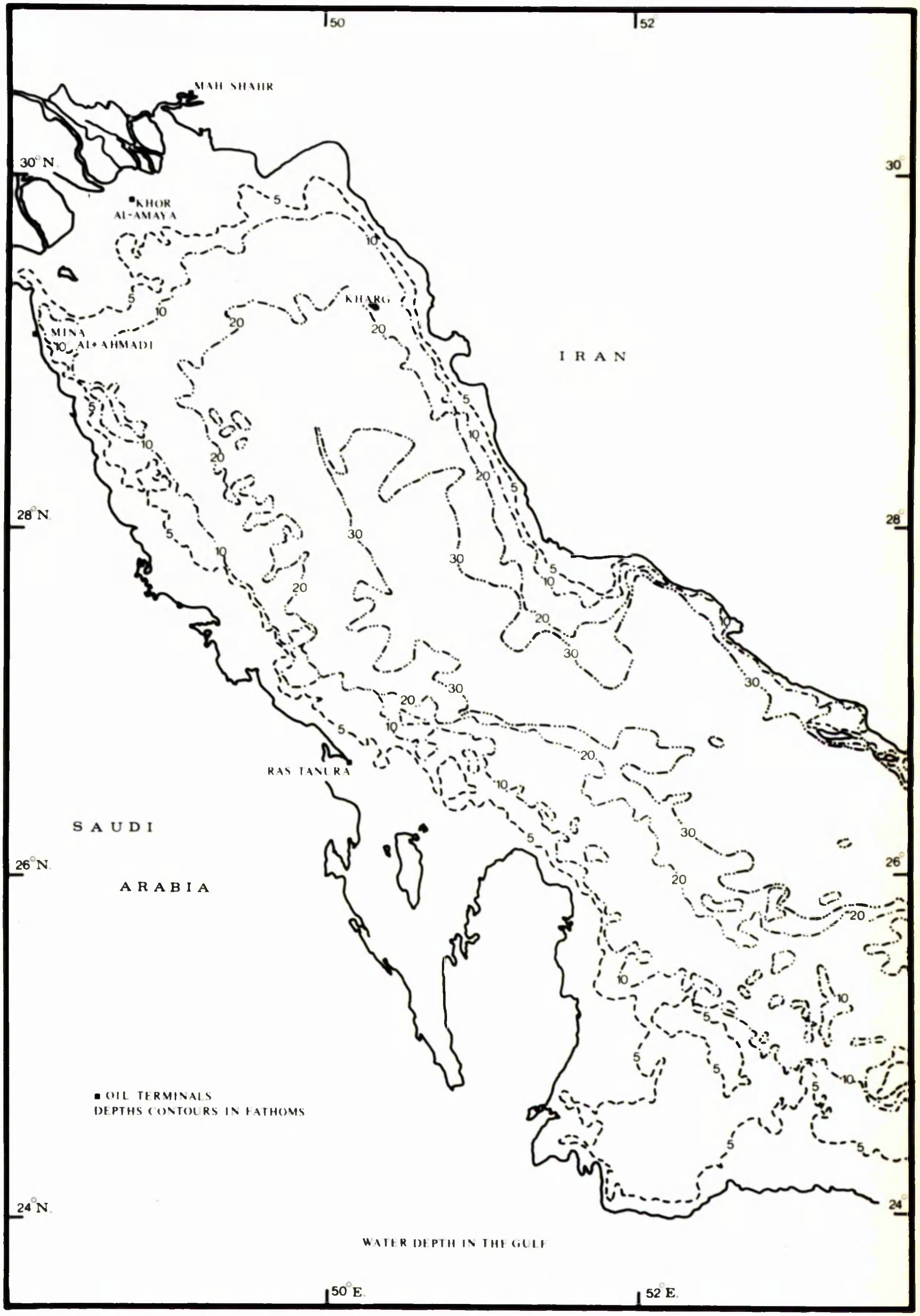
50
52
MAH SHAHR
30° N
30°
KHOR AL-AMAYA
KHARG
MINA AL-AHMADI
IRAN
28° N
28°
RAS TANURA
SAUDI
ARABIA
26° N
26°
24° N
24°
OIL TERMINALS
DEPTHS CONTOURS IN FATHOMS
WATER DEPTH IN THE GULF
50° E
52° E

Fig. 4

hose is next picked up by a crane on the tanker, and is connected to the ship's manifold, at which juncture a valve is opened, and oil commences to flow into the tanker. There are, however, several disadvantages to this system, particularly as regards maintenance of the hoses, which are made of soft, flexible material, and can easily collapse or get damaged. In this event repairs are not easily effected, as divers with special equipment are required. Other disadvantages are the slow rate of loading and the fact that in rough weather it becomes impossible to connectand load the tankers. This system is farily widespread among smaller companies operating in the Gulf, but a large percentage of tankers are still loaded at jetties. Construction of jetties has progressed correspondingly with improvements in the development of tankers. Before a jetty can be built, several important factors have to be considered, among which is water depth, both in approaches to the jetty, and at the berths. It is necessary to ensure that there is sufficient water at each berth to enable vessels to remain safely afloat at the lowest tides. Lack of shelter from the wind, waves, swell, and currents can make loading difficult and thus reduce efficiency. In general, jetties are affected by winds exceeding 25 knots, and waves or a swell of over 5 feet in height. Jetties are more efficient and reliable than buoy moorings, as they minimise loading time, and several types of oil can be handled at one time. Additional advantages of jetties lie in considerably shorter pipelines, and the ease with which tankers can be berthed, even at night, with artificial lighting. Unfortunately, these jetties are very costly to construct, and it is usually necessary to provide tugs to bring tankers alongside. However, these costs are minimised by the benefits obtained from their efficiency in operation, compared with buoy moorings.

A third system is sea-islands. These are now being built in water about three times as deep as those built several years ago. The necessity for greater depth led to their construction at a great distance from the shore, (10 miles in the case of Kuwait, and 26 miles in Iraq). This, of course, means that usually they are more exposed to storms than earlier ones. At present, these are mainly used by super-tankers.

Mina al Ahmadi (Kuwait)

i Submarine berths

Although no difficulties were encountered in bringing the produced oil to the coast, an obstacle was the loading of the oil. Kuwait has no inlets or bays with sufficient depth to enable tankers to berth. The offshore is also shallow for not less than a mile in the eastern parts, while it is shallow for several miles off the coast in the northern parts of the State. Therefore, in order to ship the oil produced in 1946, the company laid a submarine line from a point between the villages of Fahahil and Shuaiba to a distance of about a mile from the shore. The site was named Mina al-Ahmadi (Ahmad's Port) at the end of 1949, after the ruler Ahmad al Jabir. In the period 1946-47, the Kuwait Oil Company completed 5 submarine loading lines of 12" diameter. In addition, a hose buoy to which the submarine lines were connected, and two mooring buoys at which tankers could make fast, were placed in position.[7]

Loading by submarine lines meant that vessels were loading in the open sea, and consequently at any sign of bad weather the pipeline had to be released, and delays were a constant threat. These early loading facilities suffered from these severe limitations, which were not overcome until the South Pier was completed in 1949.

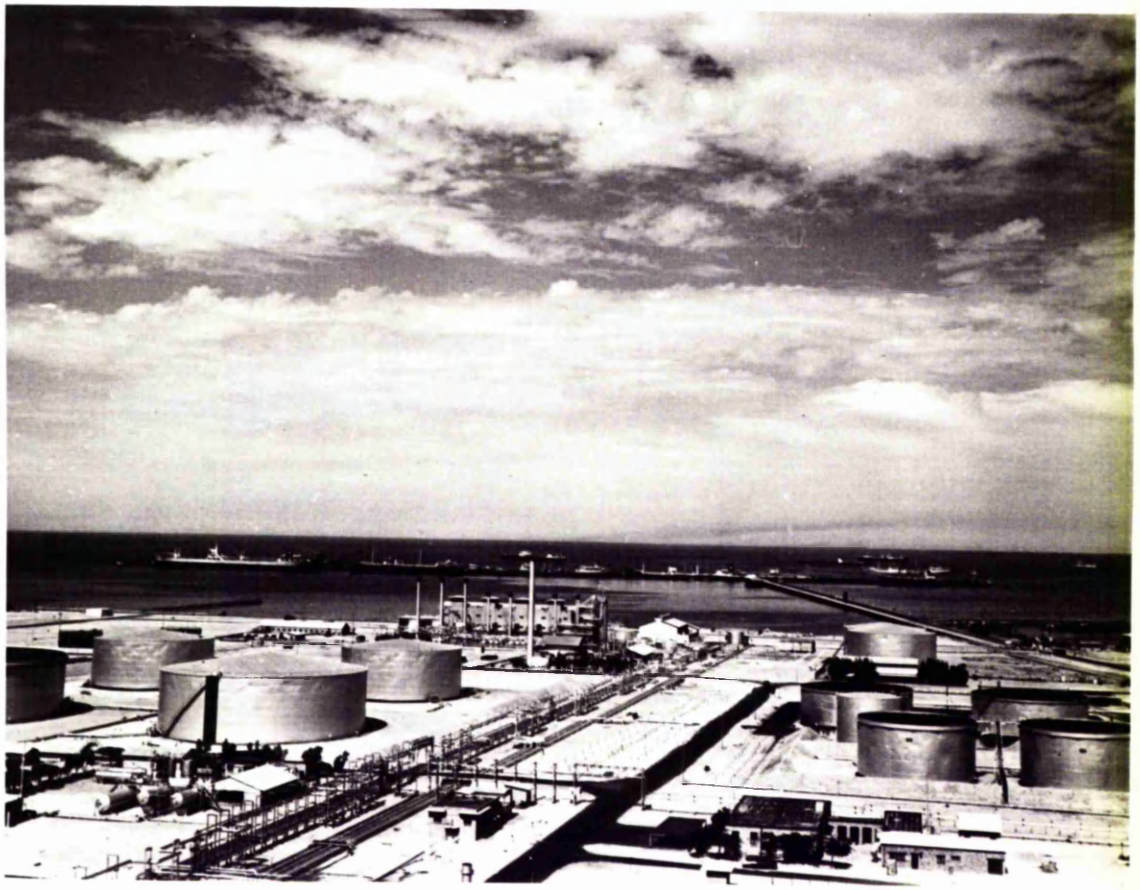

Plate 8 - A general view of the South Pier and some of the storage tanks at Mina al-Ahmadi, Kuwait.

ii South Pier

As exports increased the submarine lines became inadequate for handling the growing quantities of oil. Consequently, the Kuwait Oil Company began surveying the sea-bed near the location of the submarine lines, studying the tides (7.8' spring tides, and 1.5' neap tides at Mina al Ahmadi), in order to find a suitable area for building a pier. In 1947, the company began to construct a long "T"-shaped pier, stretching into deep water. The gently sloping nature of the sea-bed in the vicinity made it necessary for the pier to be built one mile long to a depth of water ranging between 40-49'. The pier was in full operation in 1949, and at the time was the largest of its kind in the world, having cost about $11.2 million. The northern extension of the "T" permits 6 tankers with a maximum tonnage of 100,000 dwt. to berth while the southern extension can accommodate only 2 ships. At the South Pier, the maximum loading rate is 7,000 tons per hour.[8]

While comparing the South Pier with those at other oil ports in the Gulf, such as Fao in Iraq, and Abadan in Iran, it appears that the South Pier is favoured by several factors. Fao and Abadan are both located on the Shatt al Arab river. These two ports are greatly influenced by the tide and silting, which necessitates regular dredging, a factor which limits the possibility of continuous operation, as well as the tonnage of tankers using the ports.

At Fao, the water is 32' deep beside the four jetties, and the tidal rise is between 8' and 10'. A 30,000 dwt. tanker could be handled there, although loading would be completed on a rising tide. The loading capacity ranged from 3,500 to 4,000 tons per hour. Due mainly to these problems, the Basra Petroleum Company discontinued loading from Fao in 1967, and concentrated solely on the new terminal at Khor al-Amaya.[9]

With the completion of the new pier, the company tackled the problem of bringing the oil from the shore to the ships, and at the same time took out of service 3 of the 5 submarine loading lines, whose position close to the pier rendered them no longer operative. The effect of the pier on oil exports was to permit an increase between 1949 and 1951 of 128.7%.

iii North Pier

With the increase in the size and number of tankers calling at Mina al Ahmadi, and further increases in production due to the discovery of new fields in the northern part of the country, the facilities installed could not handle the quantity of oil required for export. Thus further loading facilities were needed for the second time, and research was undertaken in 1956 in order to build a new pier capable of receiving the modern tankers which were shortly due to be in operation. The North Pier was constructed some four miles north of the South Pier, and was commissioned in June, 1959, at a cost of about $23.8 million. The pier was built in 55'-60' of water to accommodate vessels of 200,000 dwt. maximum, because at the time it seemed unlikely that there would be tankers bigger than those. The pier is "L" shaped, and stretches sea-wards for about one mile from the coast. It has 5 berths, with a maximum total loading rate of 12,000 tons per hour.[10] The largest ship afloat in the mid-60's, the Idemitsu Maru (210,000 dwt) was loaded with a cargo of 196,977 tons of crude oil in December, 1966, establishing a new record for the largest single cargo loaded in Kuwait.[11]

The Kuwaiti North Pier has many advantages over the terminals used by Iraq. The newest Iraqi terminal, Khor Al-Amaya in the Gulf, where the oil from the south fields of Iraq is loaded onto tankers, is situated 15 miles from the shore, and 26 miles from Fao. At Khor Al-Amaya, tankers of 65,000 dwt are the largest which can be accommodated, and 2 berths only are provided. The maximum loading capacity is 7,000 tons per hour at one berth, or 4,000 tons per hour at both berths together.

Oil from Iraq's north fields is exported from the Syrian ports of Tripoli and Banias on the Mediterranean. The largest tankers that Tripoli is capable of handling are 140,000 dwt. At Banias the largest is 120,000 dwt. The maximum loading rate at Tripoli is 6,000 tons per hour at 3 berths, while at Banias the figure is 7,500 tons per hour at 4 berths.[12]

Apart from the advantages previously mentioned, it may be seen from the above figures that Kuwait's one terminal can deal with 55.7% of the amount of oil dealt with by Iraq's 3 terminals. Also Kuwait is in a better position regarding its loading and unloading facilities, with the advent of super-tankers.

With the commissioning of the North Pier, the company took all the submarine lines out of service, although they are still capable of being recommissioned when necessary. With the construction of the jetties an excellent port was created. Tankers can make the port at any time of the day or night, for there are no tidal delays, nor are there offshore dangers. Tides which range between 7.8' at spring and 1.5' at neap, and tidal streams which run approximately north and south with a velocity of $\frac{1}{2}$ to $1\frac{1}{2}$ knots have no influence on berthing.[13] Although adequate fendering along the piers is provided to minimise the effect of gales and strong winds, some delays can be expected. The table below shows the average days lost at Mina al-Ahmadi in various years.

Plate 9 - The tanker "Universe Ireland" (326,000 dwt), being loaded at the Sea Island Terminal, Mina al-Ahmadi, Kuwait.

Table 7 Average days lost at Mina al Ahmadi, (1960-69)

Year	South Pier %age	North Pier %age	Sea Island
1960	9.18	9.95	-
1961	9.62	12.23	-
1962	16.79	19.32	-
1963	24.21	24.87	-
1964	17.69	17.29	-
1965	14.25	14.27	-
1966	15.15	14.29	-
1967	15.63	16.63	-
1968	18.51	18.66	-
1969	18.85	18.78	18.77

Source: Data received from Kuwait Oil Company in Ahmadi, Kuwait, April, 1970.

iv The Sea Island Terminal

The process of improving port facilities by extension of terminals even further into the Gulf seems unending. In 1959, when the North Pier was commissioned, it was assumed that tankers could not exceed 200,000 dwt, but this was disproved in September, 1968, when the first tanker in the 326,000 dwt class "Universe Ireland", came into service.

In order to make Kuwaiti oil more competitive in world markets, Kuwait Oil Company conducted a study in 1966 for further expansion of the loading facilities, by constructing a sea island terminal. This was to be capable of handling mammoth tankers of 326,000 dwt and over. In fact, Kuwait was suffering from its marketing situation, and this is noticed from the Company's daily production in 1965, when it increased by only 2.5% over the previous year. The study became more urgent when Gulf Oil Corporation (holder of 50% of Kuwait Oil Company's shares) announced its intention in June, 1966, of building 6 mammoth tankers, each of around 300,000 dwt, to transport crude oil from the Gulf to Western Europe. Always in mind, however, was the need to utilize facilities already in place, without rendering them any less effective, in particular the ability of the berths to handle smaller vessels.

In order to meet the above requirements, the Company decided to construct a new island-type loading terminal. The site of this sea island terminal is off the south and north piers and about 9.6 miles from the shore where the water depth is some 95 feet. This water is connected to deeper water by a natural channel of similar depths. This channel is about 33 miles in length and leads south-eastwards to the deeper waters of the Gulf (see Fig.2). The channel is essential for the departure of fully loaded mammoth tankers. Because of this channel's narrowness in certain areas, it was necessary to provide a system of navigational aids, i.e. 21 buoys distributed on either side of the channel and two beacons constructed on Taylor Rock and Madera Reef.[14]

The Sea Island structure comprises a loading platform with two berths, four breasting dolphins and six mooring dolphins, all fixed to the sea bottom and inter-connected by catwalks.* Each of the two berths is equipped with four 16" crude oil loading arms and two 12" bunkering arms. When the pumping system is used each berth is capable of loading at a rate of 15,000 tons per hour, whereas by force of gravity only 8,000 tons per hour is possible. The new loading facility receives the required amount of crude oil from the North and

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* The main feature of the offshore terminal is a central island formed by a jack-up barge. The legs of the platform barge were lowered to the sea bottom in about 95 ft of water. They were then driven into the sea bed to a depth of 70 feet and the barge was jacked and elevated into position. The central platform of the island measures 160 ft. by 138 ft. The structure of the terminal measures 1,620 ft. from end to end.

South Tank Farms at Ahmadi via a 48" diameter pipeline, the largest submarine line laid to date. Bunker fuel for tankers is transmitted to the sea island through a 20" diameter submarine line.[15]

In case of emergency a "crash stop" button is used to shut down operations completely. It would close emergency valves on the crude and bunker lines on the platform, isolating all the arms. Also it would shut down pumping facilities on shore and start a general alarm.

The sea island and associated facilities were commissioned in September 1968, costing 42 million dollars.[16] Two hundred and thirty nine tankers called at the sea island between the date of commissioning and the end of 1969; also, two hundred and six tankers lifted a total of 31,485,098 tons of crude oil in 1969. The six mammoth tankers now used on a regular schedule from Mina al-Ahmadi to Bantry Bay in Ireland are included in this.[17]

One thing can be remarked about the sea island before this section is concluded. The Kuwaiti Sea-Island is about 10° off line with the prevailing currents, and it is believed that it would have been better if it had been aligned 10° more to the east of north. However, to align a sea-island terminal with the current during construction is not easy. In the case of Kuwait, the terminal is about 10 miles out into the sea, where currents are not as predictable as near the shore. The effect of currents on berthing a tanker is important. It is much less difficult to berth a tanker if it is heading straight into the current as these conditions render the ship easier to control at slow speeds. Very occasionally in Kuwait the current affects ships while berthing and they then have to wait while it eases off.[18]

The table which follows shows clearly that although the number of tankers to call at Mina al-Ahmadi has decreased, the amount of oil loaded has increased, thus illustrating the fact that tanker sizes have also increased.

Table 8 Number of ships which called at Mina al-Ahmadi and the amount of oil loaded in million tons. (1960-69)

Year	South Pier	North Pier	Sea Island	Total	%age of increase	Amount loaded	%age of increase
1960	1613	844	-	2457	-	71.5	-
1961	1716	910	-	2626	6.87	73.0	2.09
1962	1726	978	-	2704	4.64	81.3	11.36
1963	1697	1018	-	2115	0.40	85.3	4.92
1964	1667	1161	-	2828	4.16	94.4	10.55
1965	1514	1054	-	2568	-9.19	96.3	2.01
1966	1604	1024	-	2628	2.33	101.7	5.60
1967	1456	942	-	2398	-8.75	102.3	0.58
1968	1351	900	33	2284	-4.75	107.5	5.08
1969	922	871	206	1999	-12.47	113.3	5.39

Source: Data received from Kuwait Oil Company in Kuwait, April, 1970.

There are several differences between Kuwait's Sea Island terminal and Saudi Arabia's at Ras Tanura. The first is that while there are 6 berths at Ras Tanura, and 6 tankers can be loaded at one time, the loading rate of about 8,000 tons per hour is not very high when compared with Kuwait's rate. Secondly, 5 of the 6 berths can accommodate tankers of up to 200,000 dwt, while Kuwait can take tankers up to 500,000 dwt. Another reason for Saudi Arabia's inability to accommodate larger tankers is the lack of water depth in the approaches to the sea-island, because although the terminal itself is located in water about 80 ft. deep, the surrounding waters are shallow. To facilitate departure, a channel has been dredged, but there is no doubt that dredging a channel and keeping it open is a costly business.*

* It is difficult to give exact figures for the cost of dredging, but it is dependent upon the hardness of the sea-bed, and the whereabouts of the dredging equipment at the time of requirement, for example, if the facilities are being employed by another company in the Gulf, it =

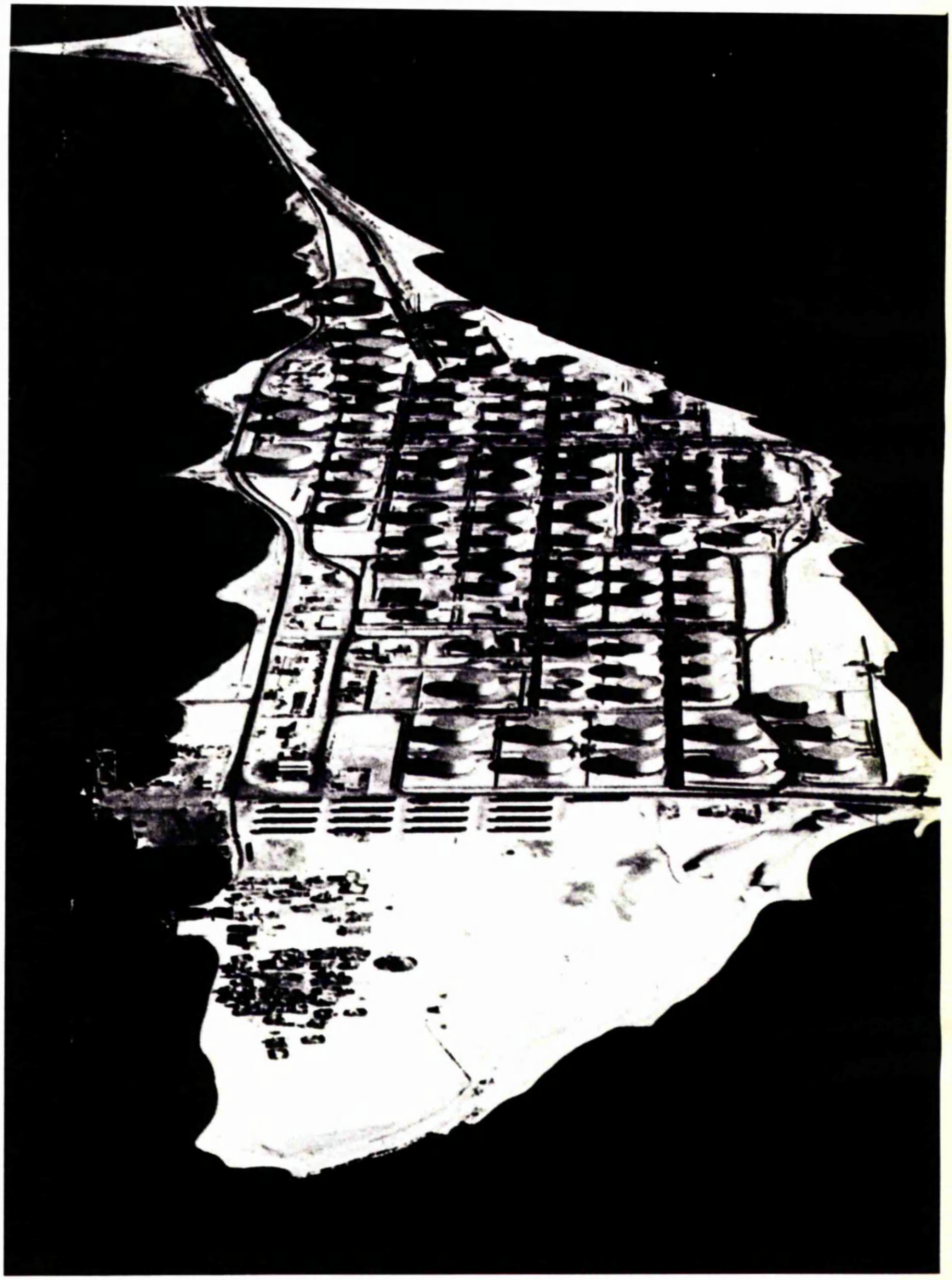

Plate 10 - An aerial view of oil storage tanks at Ras Tanura, Saudi Arabia.

Ras Tanura Terminal (Saudi Arabia)

As in the case of Kuwait, Saudi Arabia did not have a suitable sea port on the Gulf, which meant that one had to be constructed. During 1934-35 the oil company had begun to take aerial pictures of various sites, which were evaluated. The need for a depth of water sufficient to allow deep draught vessels to approach narrowed the choice down to two locations. One was Ras Tanura, sited about 25 miles from Dhahran, and the other was Dhulaifain another 26 miles further up the coast. At the same time engineers located two deep channels off the coast not far from Ras Tanura, leading in from the sea. (At present these are marked with permanent beacons over a distance of 20 miles.) Ras Tanura was selected despite a division of opinion among the Company's engineers as to the relative merits of Ras Tanura's potential harbour, and Dhulaifain's possible advantages as a refinery site.[19]

The peninsula at Ras Tanura is flat, sandy, and roughly kidney shaped. Crude tankage totalling 177,000 barrels, a 10 inch pipeline from Damman field to the tank farm, pumps and a submarine pipeline connecting the tank farm with vessels mooring 9,000 ft. offshore were completed in the spring of 1939, and oil was shipped from Ras Tanura for the first time on May 1st of the same year.* [20]

= is cheaper to hire them than if they had to be brought all the way from Europe. Also, very few companies deal in this sort of work.

* This, however, was not the first amount of oil to be exported from Saudi Arabia. In September, 1938, ARAMCO built a small storage tank and shipping terminal at al-Khobar on the Gulf, and laid a 6 inch pipeline to carry crude oil there from Dhahran. From al-Khobar oil was moved into barges and shipped to the refinery of the Bahrain Petroleum Company. Bahrain was selected to receive the oil partly because of its nearness to al-Khobar, and partly because the two Companies (Standard of Califomia and Texaco) operating in Barhain owned between them 60% of the Company operating in Saudi Arabia. In this small way, export of crude oil from Saudi Arabia started. (ARAMCO Handbook - Oil in the Middle East. Netherlands, 1969, p.117.)

Shortly afterwards, it became apparent to the Company that the submarine loading line was unable to cope efficiently with the ever-increasing number of tankers calling at the terminal. Therefore, in 1943, ARAMCO built a "T" shaped pier (the South Pier) on the eastern side of the peninsula. This pier is connected to land by a 2,300 ft. causeway, and the pier itself runs parallel to the shore for 1,200 ft. It is 105 ft. wide and the water depth alongside is 32-33 ft. On completion of the initial construction, the pier had two berths and was capable of docking two small tankers, but this was later increased to four. These four berths could accommodate tankers of about 35,000 dwt. which was then considered to be standard size. In the same year a pipeline was built from Saudi Arabia to Bahrain in order to increase export potential.[21]

Saudi Arabia's production increased with the discovery of new reserves at the end of World War II. It rose from 21,000 barrels per day in 1944 to 164,000 in 1946, and to over 476,000 in 1949. Similarly, world demand increased after the end of the war, and Saudi Arabia found it necessary to construct another pier.

The second pier (the North Pier) was built $\frac{3}{4}$ of a mile north of the first pier and out into the sea, so that a depth of 42-48 ft. of water could be made available for tankers of about 100,000 dwt. However, tanker size continued to increase and the facilities were again becoming inadequate, so in 1959 an 800 ft. extension was made to the pier, giving it a total length of 2,160 ft. The extension added another two berths to the four already in use and increased the total number of berths at the terminal to ten. The cost was estimated at the time to be 4,100,000 dollars. More improvements were made in 1964 to the North Pier where a southern extension added 200 ft. of berthing space to accommodate larger tankers. Pumps, pipelines, storate facilities and loading arms were continually being added to both piers in order to shorten the time ships spent in port or turning round, and to serve more vessels in the same amount of time.[22]

However, tanker sizes continued to increase greatly and soon reached the position where ARAMCO had to schedule the loading of certain tankers carefully so that completion coincided with high tide, or the water depth would not have been adequate to keep the vessels afloat.[23] It became apparent that the North Pier would not be able to handle the even larger tankers already being built.

In order to solve this problem, ARAMCO employed a New York firm of engineering consultants to prepare a plan for the expansion of the port. Three development proposals were suggested. One method which was considered was buoy berths, which are inexpensive to install but are costly to run because of the number needed, the length of pipeline required to connect them to the shore, and the amount of time lost through berthing problems in bad weather and darkness. This expense led to the eventual rejection of the plan. A second idea was the construction of finger, "T" and "L" shaped, piers, but again, because of the expense, this was rejected. To reach deep water, costly long trestles would have been required. The last idea was to build a sea-island terminal with two or more berths, and this seemed to be the most practical proposition.[24]

Thus on February 5th, 1964, ARAMCO decided to construct a sea island big enough to accommodate super tankers. The new Sea Island*

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* The central loading platform of the island is 80 ft. by 120 ft. with four breasting dolphins at each of its two berths to protect it from mooring stresses, and two mooring dolphins at either end. At mean low tide the platform stands 28 ft. above the water on four 6 ft. diameter steel piles protected from corrosion and driven 10 ft. into the sea bed. The central platform and the 12 dolphins are interconnected by 1000 ft. of 6 ft. wide steel walkways, making a total length of 1,250 ft. (Petroleum Times, April 15th, 1966, p.480).

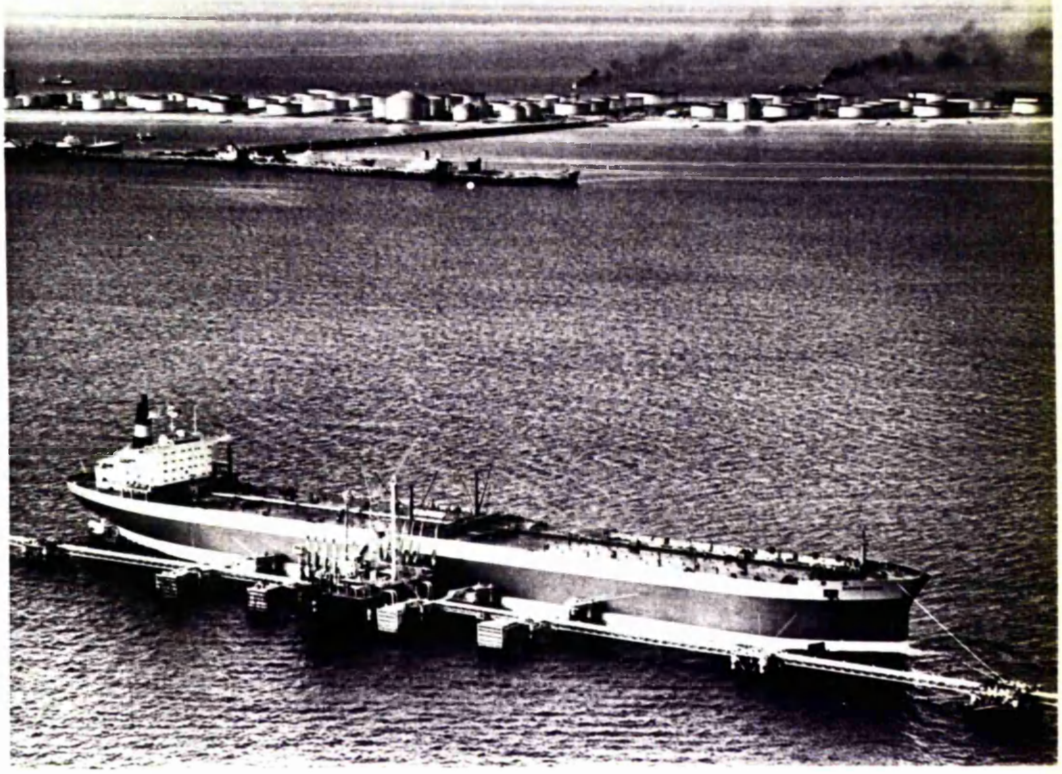


Plate 11 - A general view of Ras Tanura, showing a section of the Sea Island, the North Pier, and the storage tanks.

is positioned about one mile from the North Pier (2 miles from the shore) in about 85 ft. of water. Sea Island One, which was put into service in 1966, cost 9.15 million dollars and consists of an operating platform constructed on piles, at which two tankers may berth simultaneously.[25] Each berth is equipped with three loading arms of 16 inches which deliver up to 38,500 barrels per hour of crude to each super tanker, and two of 10 inches for the delivery of bunkers. Four submarine lines supply the deep water terminal. Three 30/32 inch crude lines and one 20 inch bunker line provide facilities for both loading and refuelling tankers. Two pumps with a capacity of 2,875 h.p. each move crude oil from the shore to the loading platform. These new facilities were expected to boost ARAMCO's exports from Ras Tanura by 500,000 barrels a day.[26]

The design of this new offshore loading facility allowed for the building of extra pairs of offshore berths in line with its axis, for further expansion. In 1966 two jack-up barges which constituted the main platform of tanker berths Nos. 3 and 4 (Sea Island Two) and berths Nos. 5 and 6 (Sea Island Three) arrived at Ras Tanura from Athens where they were constructed. The two new platforms are more or less identical with Sea Island One, and are expected to raise the export capacity by a further 1,000,000 barrels a day.[27] In 1967, Sea Island Two (berths 3 and 4) came into operation, at an estimated cost of 7,000,000 dollars and in the same year the sea bed at the North and South Piers, which was partially silted up, was dredged and restored to its former maximum depth.[28] During 1968 the Company continued to expand the facilities at Ras Tanura marine terminal by opening berth No.5 at Sea Island Three. Sea Island Berth No.6 was scheduled for completion early in 1969.[29]

Two channels connect the Sea Islands to the deep waters of the Gulf, but although some parts of these are deep, there are sections which are as shallow as 5 fathoms. (See Fig. 5). Thus, to accommodate super tankers of 200,000 and 300,000 dwt., dredging of these shallow parts was necessary. By November 1970 the northern channel had been dredged to a depth of 69 ft. (at low tide) for this purpose. This channel can now accommodate fully loaded tankers of up to 300,000 dwt., although the biggest tanker accommodated to date was 280,000 dwt. with a draught of 72 ft.[30]

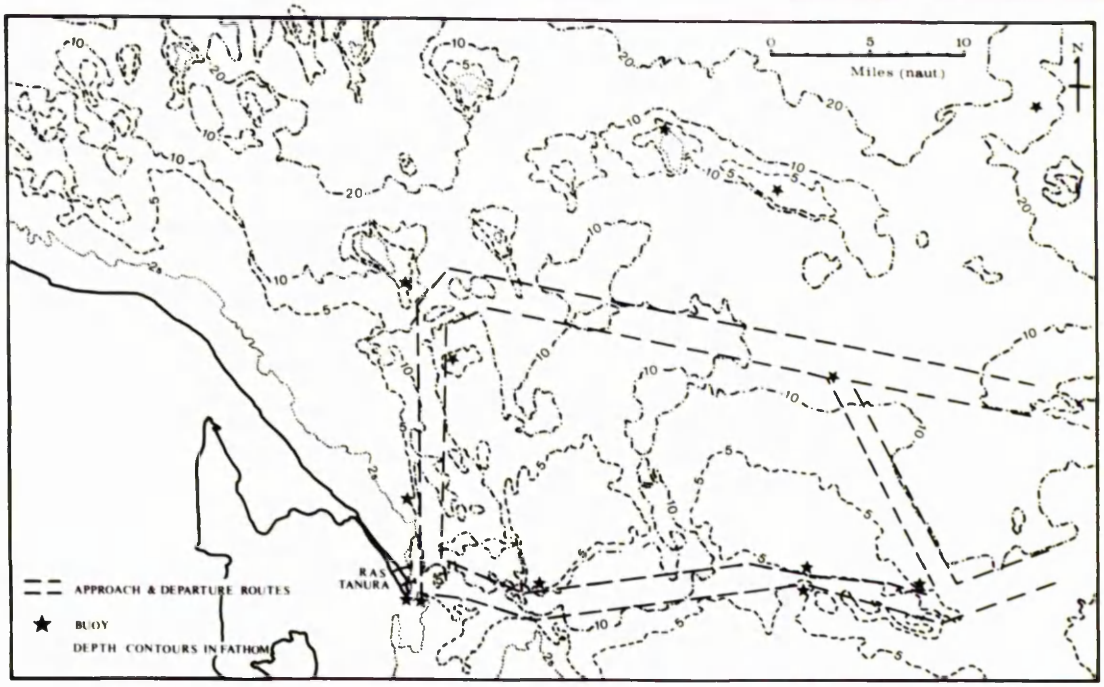
In Kuwait there is no similar problem, for although the channel there is also natural, it is very deep, and consistently so without necessity for dredging.

Ships arriving at Ras Tanura via either of the channels do not have to take a pilot on board. Both the north and south channel approaches are well marked with buoys in order to guide the vessels. If a loading berth is not immediately available vessels drop anchor in the anchorage area. Pilots guide the tankers to available berths. Approaching ships are faced with strong and irregular currents in the anchorage area and in thick weather, especially during sand storms, they are advised to anchor and ride them out, as visibility is often much less than desirable.[31]

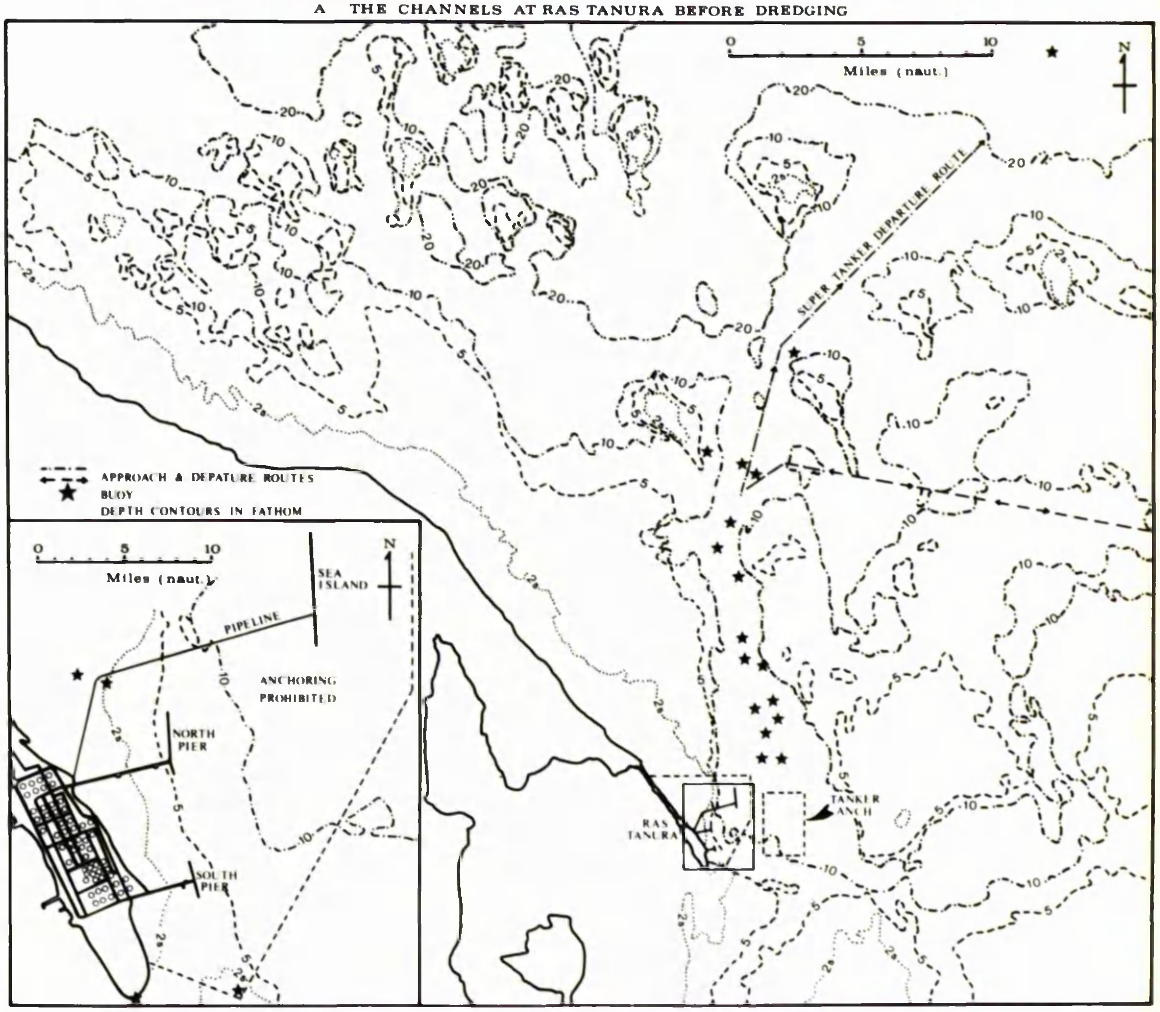
Table 9 below shows the number of ships loaded at Ras Tanura between 1964-68, while Table 10 shows the amount of crude oil shipped from Ras Tanura, compared with the amount despatched from other outlets, again between 1964-68.

Table 9 Ships loaded at Ras Tanura, 1964-68

Year	No. of ships	%age of increase	Crude and Products loaded, in tons	%age of increase
1964	2,154	-	54,149,750	-
1965	2,389	10.90	69,481,736	28.31
1966	2,677	12.05	86,686,356	24.76
1967	2,694	0.64	100,946,117	16.44
1968	2,783	2.93	107,836,094	6.82
1969	2,873		121,837,892	



A THE CHANNELS AT RAS TANURA BEFORE DREDGING



B THE CHANNELS AT RAS TANURA AFTER DREDGING

Fig. 5

Table 10 Quantities of crude oil dispatched from Ras Tanura, in comparison with other outlets, 1964-68

Outlets	Year	Dispatched amount in tons	%age of increase
To Tapline facilities at Qaisumah	1964	21,305,000	-
	1965	21,951,000	2.84
	1966	22,976,000	4.66
	1967	16,579,000	-27.84
	1968	23,527,000	41.90
	1969	16,768,000	-28.72
To Bahrain via pipeline	1964	7,518,000	-
	1965	6,466,000	-0.69
	1966	6,550,000	1.29
	1967	8,302,000	26.74
	1968	7,415,000	-10.80
	1969	7,728,000	4.22
To tankers for export at Ras Tanura	1964	42,010,000	-
	1965	55,796,000	32.81
	1966	72,934,000	30.70
	1967	85,849,000	17.70
	1968	88,561,000	3.15
	1969	101,794,000	14.94

Source: ARAMCO, A Review of Operations, 1968 and 1969

It is seen from Table 9 that the number of ships which called at Ras Tanura increased from 2,154 in 1964, to 2,677 in 1966. This illustrates the effect of the new Sea Island terminal on ships coming to Ras Tanura. Before 1966, ships calling at Ras Tanura were limited to those of low tonnage, while now ships of 200,000 dwt. or over can be accommodated at the port.

Table 10 shows the importance of Ras Tanura as an outlet, in comparison with others. It can be seen from the table that the amount of oil shipped from Ras Tanura was increasing steadily, while from the other outlets the amount fluctuated. The amount of oil shipped from Ras Tanura increased from 42 million tons in 1964, to 72.9 million in 1966, and 101.7 million in 1969, while crude oil to Tapline facilities at Qaisumah only increased from 21.3 million tons in

Plate 12 - A section of one of the 30" submarine pipelines linking Kharg Island to the mainland, emerging from the sea at Kharg Island, Iran.

1964, to 22.9 million in 1966, and decreased to 16.7 million in 1969.* The quantities of oil moved to Bahrain show a slight increase between 1964 and 1969, from 7.5 million tons, to 7.7 million. This clearly illustrates the fact that Ras Tanura has now become the main outlet for Saudi oil, and it is believed that improvements and development generally will be centred on Ras Tanura, rather than the alternative outlets.

Iranian Oil Terminals: Abadan, Mah Shahr and Kharg Island

Today, Iran ranks among the top half dozen oil producing nations in the world and is the world's second largest oil exporter. To handle the huge volume of Iranian oil exported by the Consortium, terminals have been built both offshore and on, or near, the Iranian coast of the Gulf. The terminals are Abadan, Bandar Mah Shahr and Kharg Island. The first two were designed for the export of products, while the third, the largest, was designed for export of crude oil. At present only two, Mah Shahr and Kharg Island, are operational while use of Abadan has been suspended. The following pages deal generally with each terminal.

Abadan:

Abadan, with its giant refinery, has been one of the major export terminals of the Iranian oil industry for more than half a century. From Abadan, the first oil products from the Middle East were shipped to world markets. The oil was moved 42 miles from the river Shatt al-Arab to the mouth of the Gulf. Over the years, tankers of increasing size and speed, reflecting the rapid growth and

* The decrease was mainly due to a disruption in the flow of oil. On the night of May 30th-31st, 1969, a section of the pipeline in the Israeli-occupied Gulan Heights was damaged by a group of Palestinian commandos. This act brought the flow of 475,000 b/d to a standstill. Repair work began on July 17th of the same year. (MEES Vol.XII, No.38, 18th July, 1969.)

development of the oil industry, shuttled the river to Abadan, drawing oil in millions of tons.

Up to World War II, Abadan was the Iranian oil terminal for both products and crude oil. During the war, because of the increase in the size of crude oil carriers and the growth of crude oil exports from Iran, the export of crude was diverted to Mah Shahr and Abadan was used as a product terminal. Once again in 1964, it was decided to divert the export of products from Abadan to Mah Shahr. Two reasons could be given for the last changes, the first being political in that Iran was having bad relations with its neighbour Iraq, and that the Shatt al-Arab was maintained by the Iraqi government.* The second reason was that the river port which had served Abadan refinery well for many years had come to face an uncertain future. At a time of increase in tanker size and speed, the narrow river upon which Abadan is located was nearing the end of its usefulness. It could not accommodate tankers any bigger than 16,000 dwt. and tidal conditions led to routine delays at the bar (the entrance to the Shatt al-Arab). Also, loading and sailing schedules had to be carefully co-ordinated because of the varying water levels. Eventually the situation was such that the running of the port was controlled by the moods of the river instead of being determined by the volume and class of traffic.[32]

Thus Abadan had become an expensive port, open to economic pressures, and eventually limited in the size of tankers it could accommodate. Attempts to

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* Although it is customary in cases where a river is also a boundary to divide the river equally up the deepest part, the 17th century agreement between Iran and Iraq was an exception to the rule. Authority over the Shatt al-Arab was given to Iraq, who therefore demanded dues from any cargo ship or tankers entering the river, and also from those berthing at the jetties at Abadan or Khuramshahr. In 1937, this agreement was altered somewhat, so that although dues still had to be paid to the Iraqi government on entering the river, no payment was made for berthing at Iranian ports.

obtain better modern loading rates and tanker turn-round times were frustrated by adverse tidal conditions.

Mah Shahr:

The terminal was constructed during World War II on the Khor Musa, a tidal inlet at the head of the Gulf for the export of crude oil. Khor Musa is some 67 miles overland, directly to the east of Abadan. The inlet covers an area of approximately 520 sq. miles at low tide. It consists of a triangular shaped entrance 35 miles wide and 22 miles long followed by a channel, approximately 14 miles long with an average width of about 1,000 ft. ending at the port of Mah Shahr. The Khor Musa is entered by a deep water approach channel 25 miles long and 0.8 miles wide. At the end of the approach channel (near buoy No.12) the depths are restricted, and the channel's width extends for a distance of 8 miles in the vicinity of Khor Musa Bar. (See Fig. 6.) Then there is a deep water channel ranging in depth from 40 to 60 ft., up to the Iranian commercial port of Shahpur, and to the oil company port of Mah Shahr. Despite shoals, sand banks and a low lying shoreline, the shipping channels in the Khor Musa are not difficult to navigate in clear weather, because they are well marked with buoys and beacons.33

At the time when Mah Shahr was constructed for the purpose of crude oil export, crude carriers were small in size - about 30,000 dwt. The port was extremely efficient and could deal easily with the size of vessel which was common at the time. At present, after dredging, Mah Shahr can accommodate tankers of 50,000 dwt.

Like Abadan, Mah Shahr also presented difficulties with regard to the loading of crude oil because of the increase in the size of tankers and the growth of the amount of crude oil exported from Iran. In 1964, the decision was taken

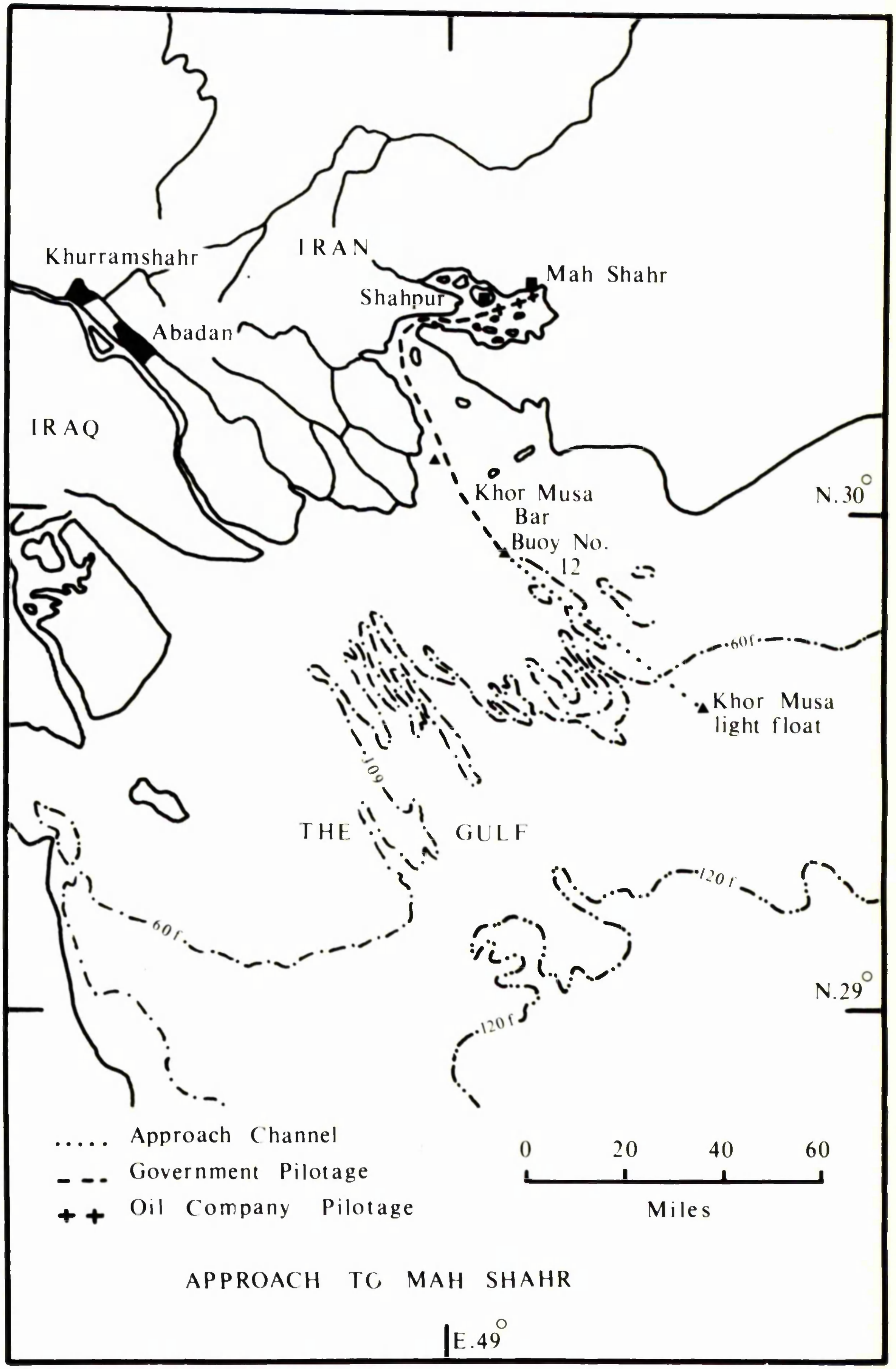
Khurramshahr
IRAN
Mah Shahr
Shahpur
Abadan
IRAQ
Khor Musa
Bar
Buoy No.
12
60f
Khor Musa
light float
N.30°
60f
THE
GULF
120f
60f
N.29°
120f
Approach Channel
Government Pilotage
Oil Company Pilotage
0
20
40
60
Miles
APPROACH TO MAH SHAHR
E.49°

Fig. 6

to convert Mah Shahr into a product terminal and to divert all the crude lines to Kharg Island.

Mah Shahr is not a very convenient terminal, because it is on an inlet in which the water depth varies considerably, and is in places very shallow, necessitating dredging. Also tankers have limited room to manoeuvre in the narrow channel and pilots have to be provided. Therefore it appears that the main reason for the selection of Mah Shahr as a products terminal were that installations were already in place and the operating companies did not wish to expend money on the construction of new facilities. Also it is not very far from Abadan.

Now Abadan's 32 products for export are moved by pipelines to Mah Shahr 67 miles away. Three 12 inch pipelines transport the refined white products and one 26 inch heated line transports the black oil products (fuel oil and diesel oil). At Mah Shahr, both tankage and loading facilities were improved upon, by the addition of 32 tanks making a total of 82, with a total capacity of 8 million barrels, and it became possible to export 350,000 barrels per day from the 6 jetties. The above modifications cost $50.4 million and the terminal was officially opened as a product terminal on December 4th, 1967.[34]

The table below shows the loading facilities at Bandar Mah Shahr.

Table 11 Jetty berths data

Berth	Least Water Depth (feet)	Maximum Capacity (dwt.)	Loading or Bunker Arms
1	44.0	35,000*	6 x 12" 1 x 10"
2	38.5	45,000	1 x 12" 1 x 10"
3	39.0	50,000	3 x 12" 1 x 10"
4	37.0	40,000	3 x 12" 1 x 10"
5	39.0	55,000*	5 x 12" 1 x 10"
6	43.5	60,000*	4 x 12" 1 x 10"

* Subject to overall length not exceeding 780 ft., and the rise of the tide on the Khor Musa Bar.

Source: Iranian Oil Refining Company publication, Port information – Mah Shahr Terminal, Tehran, December, 1968.

Kharg Island Terminal:

i. The first-phase development

As mentioned previously, Bandar Mah Shahr proved to be inadequate with regard to loading and accommodating tankers, because of the rise in world demand for crude oil and the increase in the size of tankers. Therefore a deep water port with facilities to berth the supertankers, and for rapid loading was required.

Thus attention turned still further south, as the water becomes deeper in that direction. In 1958, the Iranian Oil Companies began to develop an oil terminal on Kharg Island, some 25 miles off the Iranian mainland. (The distance from the mainland is equal to the width of the English Channel at the Straits of Dover.) The terminal was initially designed for the export of heavy crude oil from Gachsaran,* an oilfield about 100 miles east of Bandar Mah Shahr, high in the foothills of the Zagros mountains. Kharg Island proved to be more convenient than Mah Shahr for the export of Gachsaran crude oil, because of its proximity to the field (about 100 miles), and its possession of deep water capable of accommodating the largest tanker afloat at the time.

Kharg Terminal was linked to Gachsaran by a pipeline 100 miles long, of which some 75 miles of 26 - 28 inch pipe were laid over the mountains and plains to the coast near the little port of Ghanaveh. The line started from a maximum elevation of about 2,000 ft. above sea level. Then it descended to lower plains between the sea and the mountains and ended at Ghanaveh escarpment 35 ft. above sea level. The final 25 miles was made up of a 30 inch

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* The field was discovered in 1936 and had a daily production capacity of 25,000 barrels. After World War II, the field was connected to Abadan Refinery to process the output by a 12 inch pipeline, but it was not until 1956 that Gachsaran was selected for intensive development.

submarine pipeline from Ghanaveh to Kharg Island.[35] On Kharg Island itself, a tank farm was constructed. This is located on an elevation of about 200 ft. about one mile from the shore, which means loading of oil by force of gravity. It consisted of 12 crude oil tanks, 8 of which have a capacity of 140,000 barrels. In addition 3 tanks were built for products. Of these, 2 tanks have a combined capacity of 280,000 barrels of bunker fuel oil, and the remaining tank with a capacity of 59,000 barrels for diesel oil.[36] Also an L-shaped jetty* was built in a water depth of between 64 and 67 ft. with four berths (see Fig. 7). The jetty, which is situated on the west side of the Island, is protected from the violence of the north westerly winds by a central plateau of some 250 ft. The loading rate was about 10,000 tons per hour, with a total throughput capacity of approximately 800,000 barrels per day.[37] The terminal was commissioned in 1960, costing about $89.6 million.[38] With the construction of the above facilities, Kharg Island crude oil terminal compared favourably with any terminal in the international oil industry.

ii. Second-phase development

The Kharg Island Terminal has been developed and expanded over the years since the initial construction work was commissioned in 1960. The development was carried out in different stages, where new facilities were added to enable the terminal to cope with the increasing world demand for oil.

After some years of careful study, construction on a new phase of Kharg development was commenced towards the end of 1964, at a cost of $22,750,000. With the completion of this project in 1966, Kharg Island became one of the largest crude oil export terminals in the world. This was due to the construction of extensive facilities in the new phase, such as enormous submarine and overland

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* The jetty, which is situated 4,000 feet from the shore, is approached by a rock filled causeway some 1,500 ft. long and 140 ft. wide extended by an approach trestle of some 2,500 ft. long and 60 ft. wide.

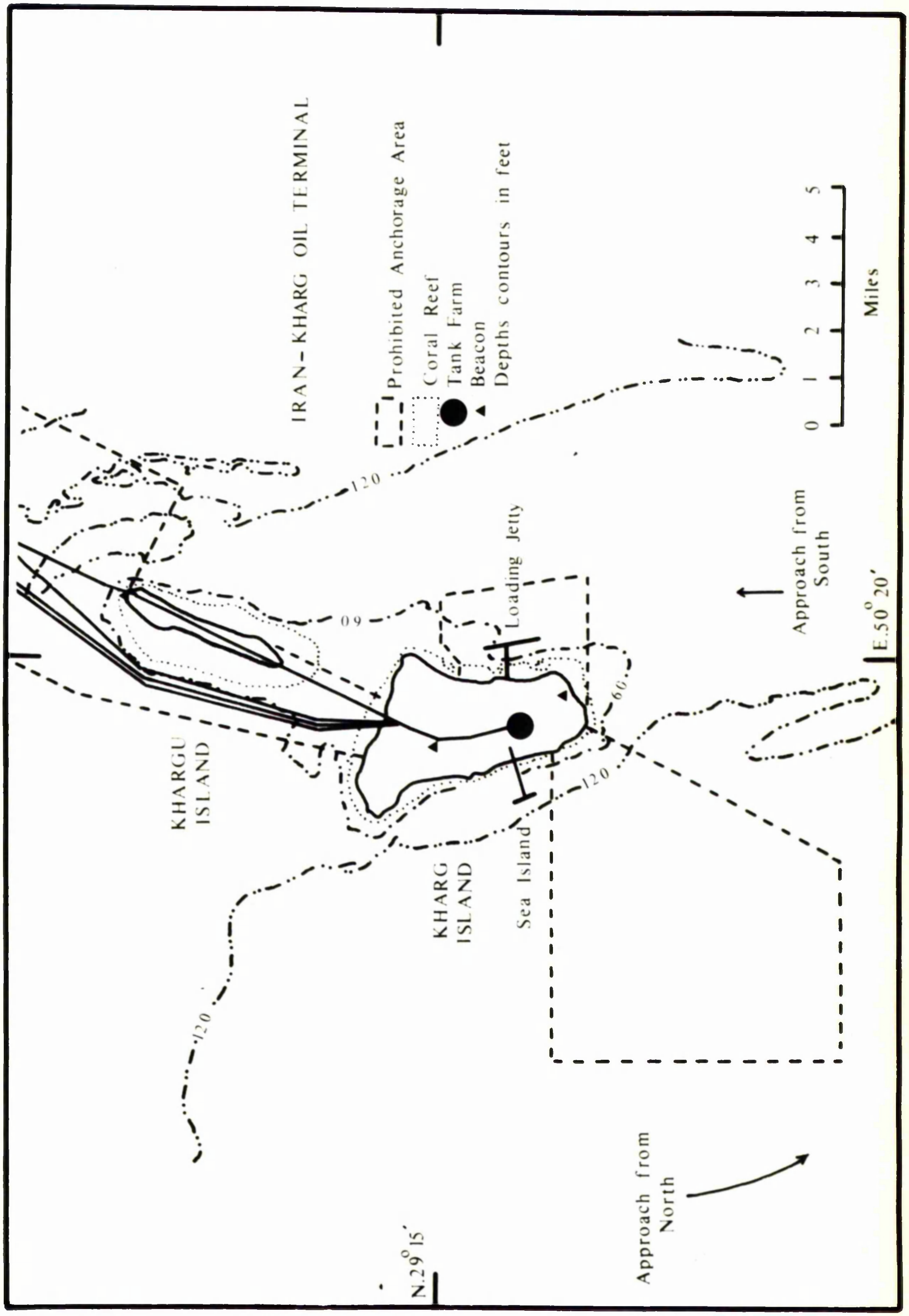
IRAN-KHARG OIL TERMINAL
Prohibited Anchorage Area
Coral Reef
Tank Farm
Beacon
Depths contours in feet
0 1 2 3 4 5
Miles
120
60
Loading Jetty
Approach from South
E.50°20′
KHARGU ISLAND
KHARG ISLAND
Sea Island
Approach from North
N.29°15′

Fig. 7

pipelines. The constructions carried out were as follows:

Land lines:

Two pipeline systems now move the produced oil from Gachsaran and Agha Jari fields to a location close to the small port of Ghanaveh. The Gachsaran lines are to transport the heavy crude oil and the Agha Jari line for the light crude. The two fields, Gachsaran and Agha Jari are widely separated.

Gachsaran:

As mentioned when discussing the first phase of Kharg development, the first Gachsaran line was commissioned in 1960. In 1965, due to increasing production, a second 26/30 inch land line was laid parallel to the first, doubling the through-put capacity from the Gachsaran field and tying in to the Gachsaran trunk-line system the recently discovered Bibi Hakimeh field. The overland portion of this line is some 75 miles long, starting at production Unit No.2 and ending at Ghanaveh. About 40 miles of the line passes over mountains. The estimated cost of building this was £7,560,000.[39]

Agha Jari:

The land line for light crude from Agha Jari to Ghanaveh was built in 1965 at an estimated cost of £22,960,000. It is the largest crude oil delivery line in the world and has an initial throughput capacity of almost a million barrels per day without boosting. The line has a total length of 133 miles from Agha Jari to Kharg Island. The land portion of this is 106 miles long and 42 inches in diameter. The choice of 42 inches was due to the huge off-take from Agha Jari and the rising output from the adjacent fields. Starting at Ummideyeh, the line collects oil from Agha Jari, Karanj, Faris, Pazanan and Marun (production

Units Nos. 2 and 3) fields. It took about 5 months to build the line, from mid-July 1965 to November of the same year.[40] The line started at an elevation of 100 ft. above mean sea level, then crossed River Zeydun after 28 miles. The line reached its maximum elevation of 810 ft. at 52.8 miles (almost in the centre), from where it descended to the lower levels of the mainland and terminated at Ghanaveh.

When filled, the line contains approximately 957,000 barrels of oil taking a little less than one day to travel the length of the land line, moving at the rate of about 4.5 miles per hour.

The initial push given to the oil flow is from the production Units at Agha Jari from which eight pipelines tie-in. The tie-ins include three 12 inch lines from production Unit No.1, a 16 inch and a 12 inch line from Unit No.2, a 20 inch and a 16 inch from Unit No.3, and 20 inch from Unit No.4.[41]

Submarine lines:

Altogether four 30 inch submarine lines have been laid between Ghanaveh and Kharg Island. The maximum depth to the sea floor between the island and the mainland is 150 ft. The first was laid in the winter of 1959-60. Since then, three additional submarine lines have been laid. The second was laid in 1964, the third and fourth were laid in the summer of 1965, parallel and to the west of the first two.

The construction cost of the second, third and fourth lines was estimated at $14,560,000.[42]

Tank farms:

With the construction of the above pipelines to Kharg, the storage capacity on Kharg became inadequate to store the amount of oil moved there. Thus construction of new tanks was inevitable. Since the products storage capacity was too small to meet the enlarged requirement of Kharg, it was

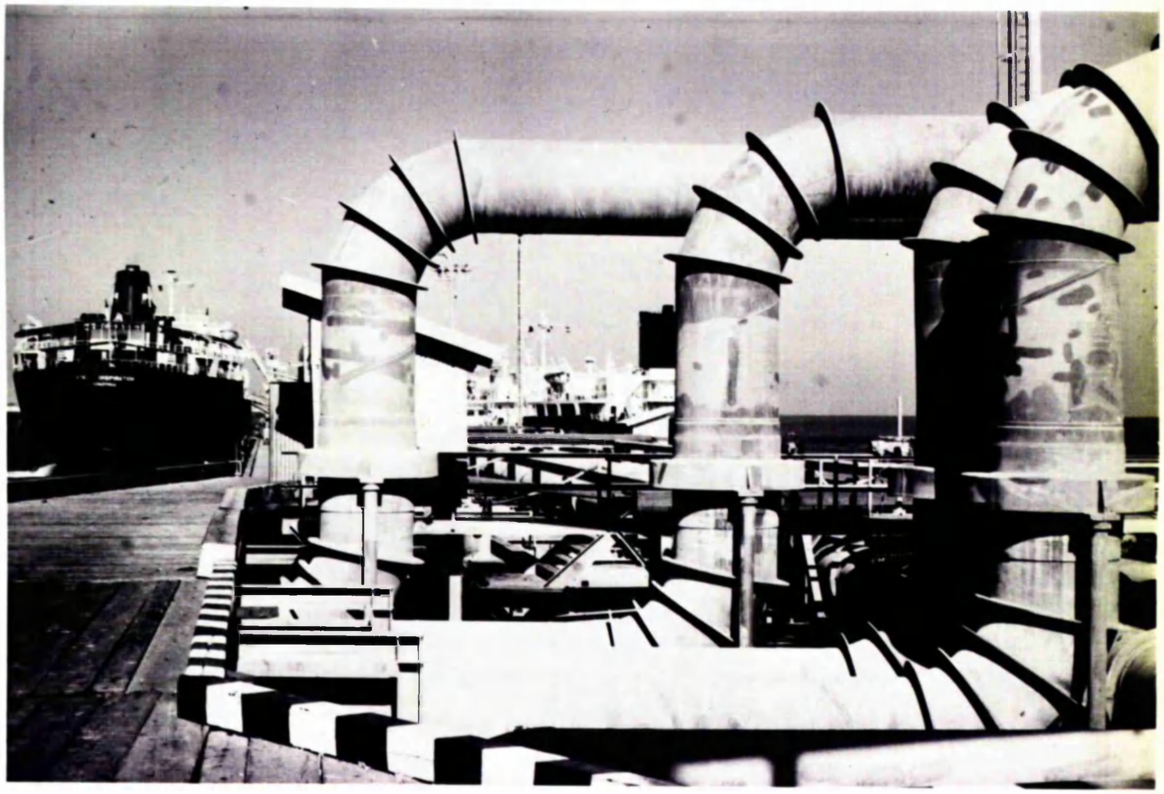

Plate 13 - A section of the jetty and the four 30" diameter loading lines at Kharg Island, Iran.

decided to transfer 4 tanks of 140,000 barrels used for the existing crude oil, over to products. This diversion added some 560,000 barrels to the products storage capacity and almost tripled it. With regard to crude oil, 11 tanks of 500,000 barrels were added to the remaining 8 tanks (total capacity 2,176,000 barrels) making a total capacity of 7,676,000 barrels. The cost of constructing the new tanks was estimated at $7million.

Apart from the above changes, the submarine lines coming from the mainland were also extended to the Flow Control Station, using a 30 inch pipe. From this point a new 48 inch buried line was added to the existing 38 inch line to the tank farm. From the tank farm 4 x 58 inch loading lines were added to the existing 2 x 36 inch lines to increase the loading capacity.

With these accomplished, two different types of crude oil, the light crude from Agha Jari and the heavier from Gachsaran were routed directly from the mainland fields under the sea to the appropriate tanks and dispatched without mixing from the tanks to loading facilities by gravity flow.[43]

The jetty:

The expansions were not confined only to the construction of pipelines and tanks, but also covered the loading facilities. The four berth L-shaped jetty was expanded to a ten berth T-shaped jetty with a frontage of 6,000 ft. This was accomplished by addition of 1,200 ft. to the south of the "L" and 2,800 ft. to the north. Apart from the above extensions, the approach trestle was widened from 60 to 87 ft. to accommodate additional loading lines. In extending the jetty and widening the trestle, some 25,000 tons of structural steel were required. The construction work of the jetty was completed by about mid-1966, and the estimated cost was $40.6 million. At present, the jetty with its 10 berths is able to load 5 tankers of 100,000 dwt. and over, plus 2 in the

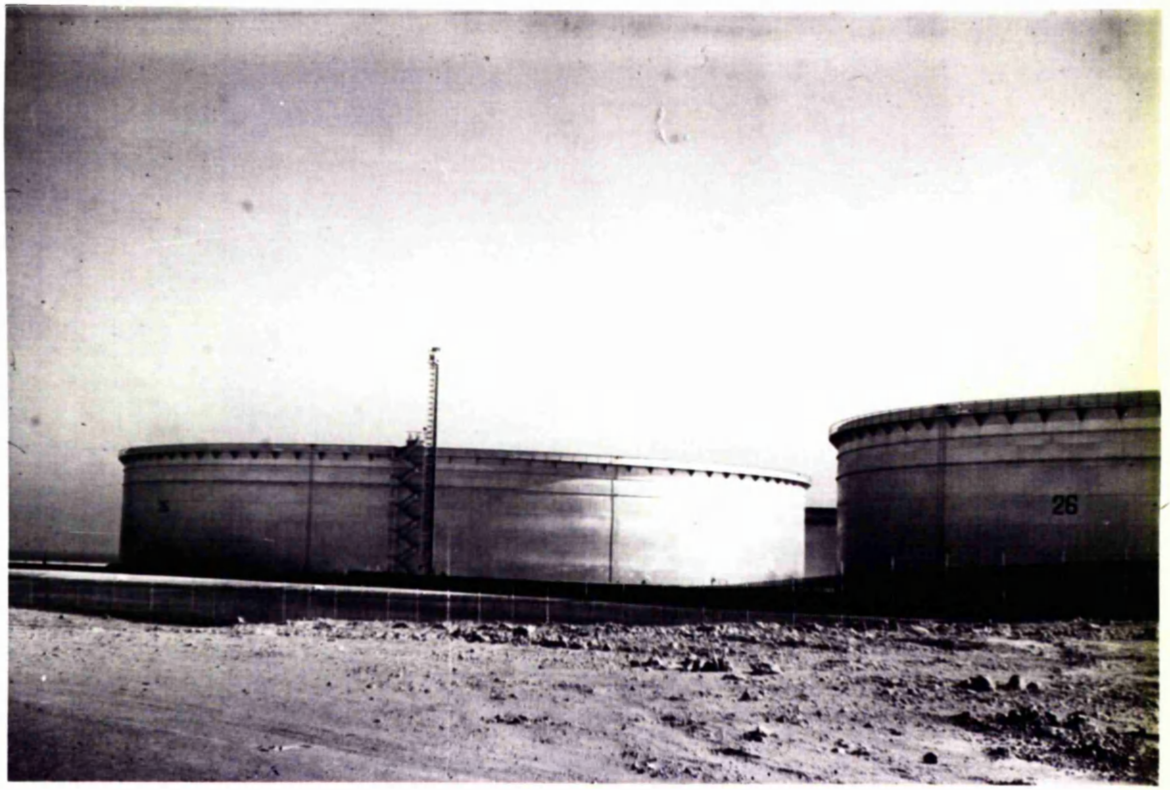

Plate 14 - Two of the five, one million barrel storage tanks at Kharg Island, Iran.

65,000 dwt. range and 3 in the range between 35,000 and 45,000 dwt.[44]

These major improvements led to time saving when loading, increased capacity and flexibility in delivering either light or heavy crude oil. With these achievements, Kharg crude oil terminal possessed a leading position in the oil trade.

iii. Third-phase development

One of the results of the closure of the Suez Canal was the increased size of tankers which in turn necessitated the modification and enlargement of crude handling facilities. In 1968, the planning for Kharg third phase development was commenced. In this phase, the storage capacity was enlarged by the addition of 3 x 1,000,000 barrel tanks and one of 500,000 barrels. The 3 x 1,000,000 barrel tanks are the largest storage tanks ever built in the world. By May 1971, the number of these tanks had risen to 5, in order to be able to supply oil to the sea-island terminal at Kharg which is at present under construction.* Another reason behind building such tanks appears to be that it is more economical for a big oil company with a large output to construct a storage tank of one million barrels than to build 4 x 25,000 barrels or 2 x 500,000 barrels. A one million barrel tank costs about $1.1 million as against $750,000 for one of 500,000 barrels.[46]

Also the plan included some modification in the loading systems. As a result, the terminal at present is capable of handling oil at a maximum rate of 60,000 tons per hour. In order to cope with tankers in the range of 200,000 dwt. and 250,000 dwt., the fendering systems at berths Nos. 1, 3 and 5 were strengthened and the area at these berths as well as their approaches has been dredged to a depth of 70 ft. The cost of dredging was estimated at $720,000.

* The base of a one million barrel tank covers an area of 488 feet square at a height of 249 feet above sea level. The diameter is 375 feet, and the height of the walls is 56 feet. After the foundations are laid, the area is covered with steel plates ¼ inch thick, while the walls are constructed of plates 8 feet wide and 1.5 to 0.375 inches thick.

(the dredge area was small and the sea-bed was soft.)[47]

iv. Fourth-phase development

The Sea Island terminal:

Kharg terminal was built in 1950, and it was not built with 200,000 tonners in mind, as they had not been thought of at that time. The biggest tankers then were about 60,000 dwt. and tankers of 100,000 dwt. had been planned. With the advent of 200,000 tonners, 3 berths at the terminal were dredged to accommodate them. In 1968, the Iranian oil companies realized that in a year or two they would be unable to accommodate the tankers which were being planned, and obviously, if the demand is to take oil out in bigger tankers, it has to be met as long as it is practical and reasonably economical. Occasionally, bigger facilities are required because ships have got bigger before the production actually demands more facilities, but more frequently the two requirements come together. The present installation at Kharg is in the second category, it is running to capacity, and the demand for oil is going up 8 - 9% per year.

Quite obviously, if a lot of money is going to be invested in a new terminal, as at Kharg, provision must be made for future developments, especially for increasing sizes of tankers. Thus a basic requirement was that the new facility should be built in 100 feet of water, as the exact draught of the very big tankers cannot be guessed at. A 500,000 tonner could have anything from 80' - 95' draught, and there is the possibility that an even bigger ship might be built. Another point to be considered while selecting a site is the fact that the deeper into the sea it is, the more expensive it gets, as longer pipelines are needed, and the pressure drop is greater. Thus, under force of gravity, the flow rates reduce the further out the pipelines have to go. Also, the structure itself becomes more costly, as longer piles are needed. In fact it was originally planned to construct the island further out, but the cost became prohibitive, and the increased flexibility was not worth the extra money. The site which was finally decided upon is on the exposed western side of Kharg Island. The prevailing winds come from the north-west, and from that point of view it is not the ideal site, as there will be a lot of weather interference. Unfortunately, the other, more sheltered side of the island has shallower water, and the only places with the required depth of water between Kharg and the mainland are some 3 - 4 miles from the island. Building there would again incur extra expense through longer pipelines, and pressure loss would be so great that pumping would be necessary. Thus the extra cost is so much more that it does not justify doing it. It is cheaper to build on the exposed side, close to the island, and accept the fact that in some weather conditions it will be unusable.

The pipelines to serve the new terminal will be gravity loading, at a rate of about 30,000 tons per hour. There will be 2 crude loading lines, one each for light and heavy oil, and one bunker line. The crude lines from the tanks to the shore will be 78" in diameter, and from the shore to the terminal they will be 56". These pipelines will be the largest in the world when they are completed. The bunker line will be 20" in diameter. When these pipelines were being planned, future expansion was taken into consideration, which accounts for their vast sizes.[48]

Also, the new Kharg terminal will be only about 4,500 ft. from the shore, and it is therefore economical to install bigger pipelines, and provide a better loading rate than anywhere else. For instance, in Kuwait, with very high horsepower pumps and a 48" pipeline, a pumping rate of 15,000 tons per hour can be achieved along the 10 mile line, but although it would now be economical to increase this rate, it would mean building another pipeline, which is very expensive.

Of course Iran has learned from watching the operation of Kuwait's terminal, and in the design much emphasis has been placed on possible future expansion. It will be possible to install pumps ashore, and increase the flow rate to 60,000 tons per hour, without altering the pipeline system. This is in anticipation of tankers of 700,000 tons in perhaps 5 or 6 years time. These would be able to load at about 40,000 tons per hour, leaving the other 20,000 tons for loading smaller ships.

The estimated cost of the terminal is $38,000,000, and it is programmed for completion in 1972.[49]

The length of the new sea-island will be 1,800 feet, and it will have two berths capable of handling tankers of 500,000 dwt. If it is loading to capacity, i.e. a tanker of 300,000 tons on one side, and another of 500,000 tons on the other side, between them the two tankers will be taking on more oil than any single oilfield in the country can produce in 24 hours at present rates of production. Thus, when the new super-tankers have been built and are in use, the new sea-island will double the export capacity of the Kharg Island Marine Terminal.

In discussing the main terminals of the Gulf with regard to their geographical inhibitions on flexibility for future expansions, they have been arranged in ascending order of merit as follows:-

1. Iraq:

Iraq has a very short coastline on the Gulf, and the approaches to this at any point are shallow, thus limiting chances for expansion. Iraq established Fao as an oil terminal on the Shatt al-Arab, but this soon proved to be unable to accommodate the larger tankers, and these were further increasing in size. In order to increase exports, in 1962, the Iraqis built the Gulf's first Sea Island terminal (Khor Al-Amaya) about 20 miles from the shore. This terminal is situated towards the south-east of the mouth of the Shatt al-Arab, 26 miles from Fao, and is further out into the Gulf than the others. While the Iraqis went as far as possible into the Gulf to build their terminal, they did not overcome all the problems of loading, as the biggest tanker that can approach the terminal is under 100,000 dwt., and with increases in tanker sizes today, this is not adequate to compete with other countries. Also the distance from the shore has created another problem, as the levels of the tides change, and the current tends to go round in a circle. If a tanker encountered such a current while berthing, it would be liable to strike the terminal with a heavy impact. Therefore at certain conditions of tide and current, it is not possible to berth.

Another disadvantage of Khor Al-Amaya as a terminal is political. In June, 1969, NIOC produced a map (TR 3637) which locates the terminal in Area 1 of District 1 of the Iranian Continental Shelf (see Fig. 8). A verbal agreement between Kuwait and Iran (see Chapter One - Offshore Boundaries) regarding the division of the offshore boundary was opposed by Iraq, probably because Iraq was hoping for about 3 times the area which was left to her, and also from fear of losing Khor Al-Amaya, and being without a deep water terminal.

2. Saudi Arabia:

Saudi Arabia was able to improve on Ras Tanura by building three new sea-island terminals, where it is now possible to accommodate super-tankers. To enable this kind of vessel to approach the terminal, the approach channel had to be dredged and this was a costly business.

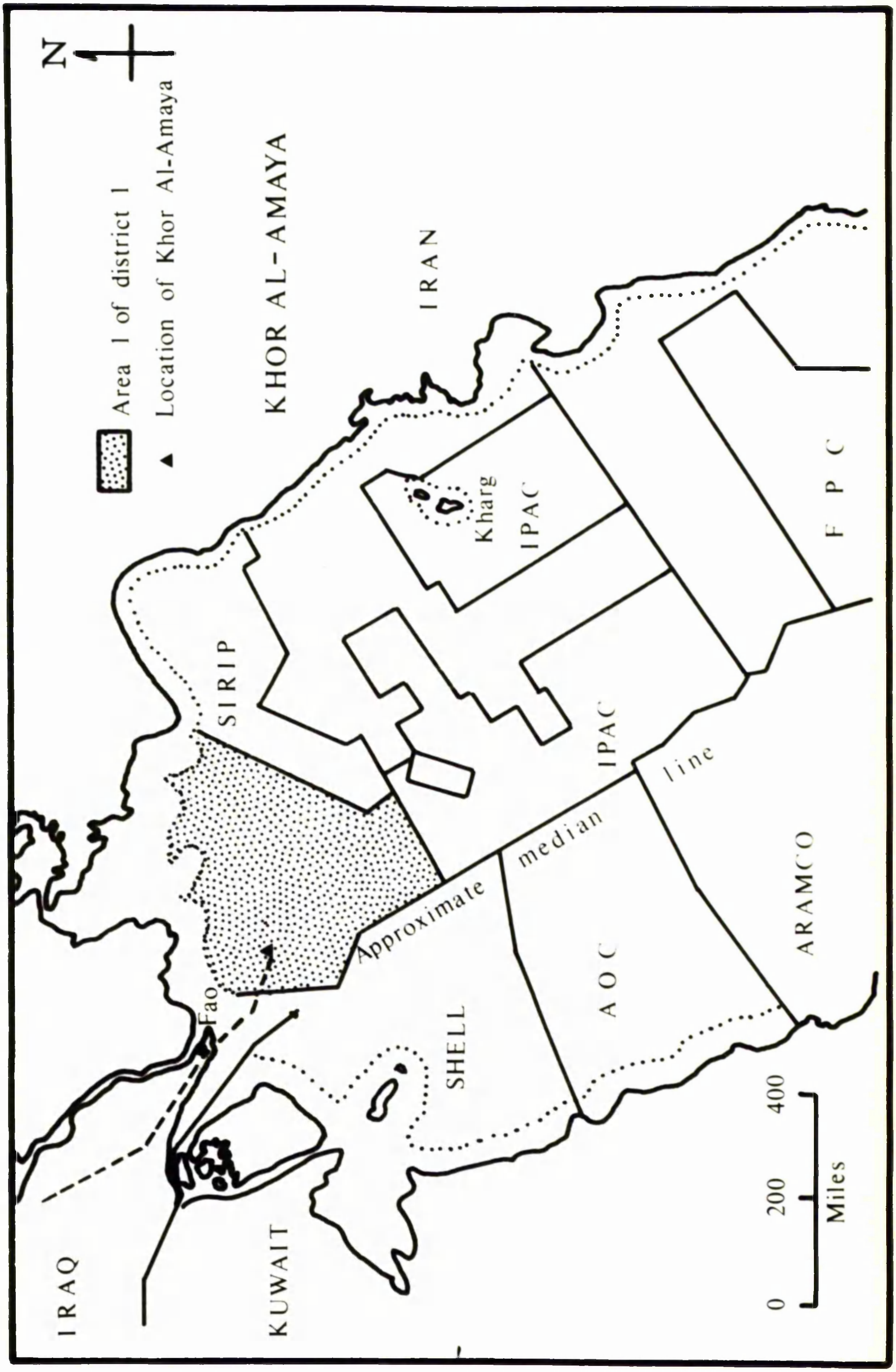
N
Area 1 of district 1
Location of Khor Al-Amaya
KHOR AL-AMAYA
IRAN
IRAQ
KUWAIT
Fao
SIRIP
Kharg
IPAC
IPAC
FPC
SHELL
AOC
ARAMCO
Approximate median line
0
200
400
Miles

Fig. 8

3. Kuwait:

Kuwait improved upon its loading system by building its sea-island about 10 miles from the shore where it was lucky to find a naturally deep channel leading to the deep waters of the Gulf. Here in contrast to Saudi Arabia, Kuwait went further into the sea to avoid having to dredge. If Kuwait had built its terminal closer to the shore dredging would have been necessary.

4. Iran:

Iran is the most fortunate country in the Gulf with regard to the expansion of terminals, because the deepest part of the Gulf is to the east. Although moving terminals is a costly job, Iran was able to move its terminals from Abadan, when it became unsuitable for loading crude oil, to Mah Shahr and then to Kharg. Other countries in the Gulf cannot do this because of the lack of water depth. The only thing they can do is to go further into the sea in order to reach deep water. The future Iranian sea-island at Kharg finds water about 105 ft. deep only 4,500 ft. from the shore which is better than both Iraq and Kuwait, as it is less far out to sea and therefore less expensive to construct.

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CHAPTER V

GEOGRAPHY OF TRANSPORT

When oil production was in small quantities, it was stored and transported in cans and barrels. The rapid expansion of oil production involved the invention of new, more efficient, speedy, and economical methods. Tankers, large storage tanks, pipelines, rail tanks, and motor tankers were developed for carrying and storing crude oil and refined products.

When a country participates in both production and consumption, the location of the refining facilities depends on local conditions. They may be constructed near the oilfield, with products being transported to where they are needed, or they may be built near the consuming centre, in which case the main transport movement is of crude oil. Apart from North America and the U.S.S.R., there are no important areas where production matches consumption. Thus it becomes necessary to move the produced oil from one area to another. The movement of oil from the oilfields to the ultimate consumer is complex. The simplest chain consists of three links - oilfield to loading port, sea transport to seaboard refining, and delivery of products by road to the consumers.

1. Tankers

Development

During the 1920's, oil production which exceeded local demand was developed in Central America, the Caribbean, the Middle East, and the Far East (mainly in the Dutch East Indies, now Indonesia). The surplus was needed to supply other parts of the world, particularly Western Europe. Owing to the limited quantities of oil involved in transportation, the size of tankers was small (about 10,000 tons dead-weight - dwt.). During the Second World War tanker size slowly grew, and reached over 16,000 tons dwt.

In the years immediately after the War, demand for oil rose rapidly, mainly due to the damage done to coal mines which until then had been the main source of fuel. The total world demand for energy between 1938 and 1947 increased by 26%, and this increase was met by oil.[1] The increased demand had a great effect on tanker tonnage. In 1948, the first of many 30,000 tonners was built, and in late 1954 the first vessel of a little over 50,000 tons was ordered. At that time these vessels were referred to as "giant tankers". Less than two years later, the first of a series of 80,000 tonners was launched, followed towards the end of 1958 by the first of the 100,000 tonners. There was then a pause until the first half of 1962, when a ship of about 130,000 dwt. was launched by a Japanese oil company. In 1966, tonnage rose to 209,000 dwt., and in 1968 it reached 300,000 tons.[2] However, there would be no technical problems in building tankers of 500,000 tons dwt. or even of one million.[3]

It may be noted from Fig.1 that the world's total tanker tonnage was increasing steadily between 1945 and 1956, during which time it increased from 24 to 44.5 million tons. The period 1964-68 showed a sharp increase from 81 to 134 million tons. This enormous growth was related to technological advances in the design of vessels, the emergence of new oil companies into the business, and the two closures of the Suez Canal, which resulted in small tankers becoming very costly to operate. (The route was changed to go via the Cape of Good Hope.)[4]

In the first half of 1970, new tanker deliveries amounted to about 8.5 million tons. This represents an increase of 1.5 million tons over the corresponding period of the previous year, but is below the record amount delivered during the second half of 1969.

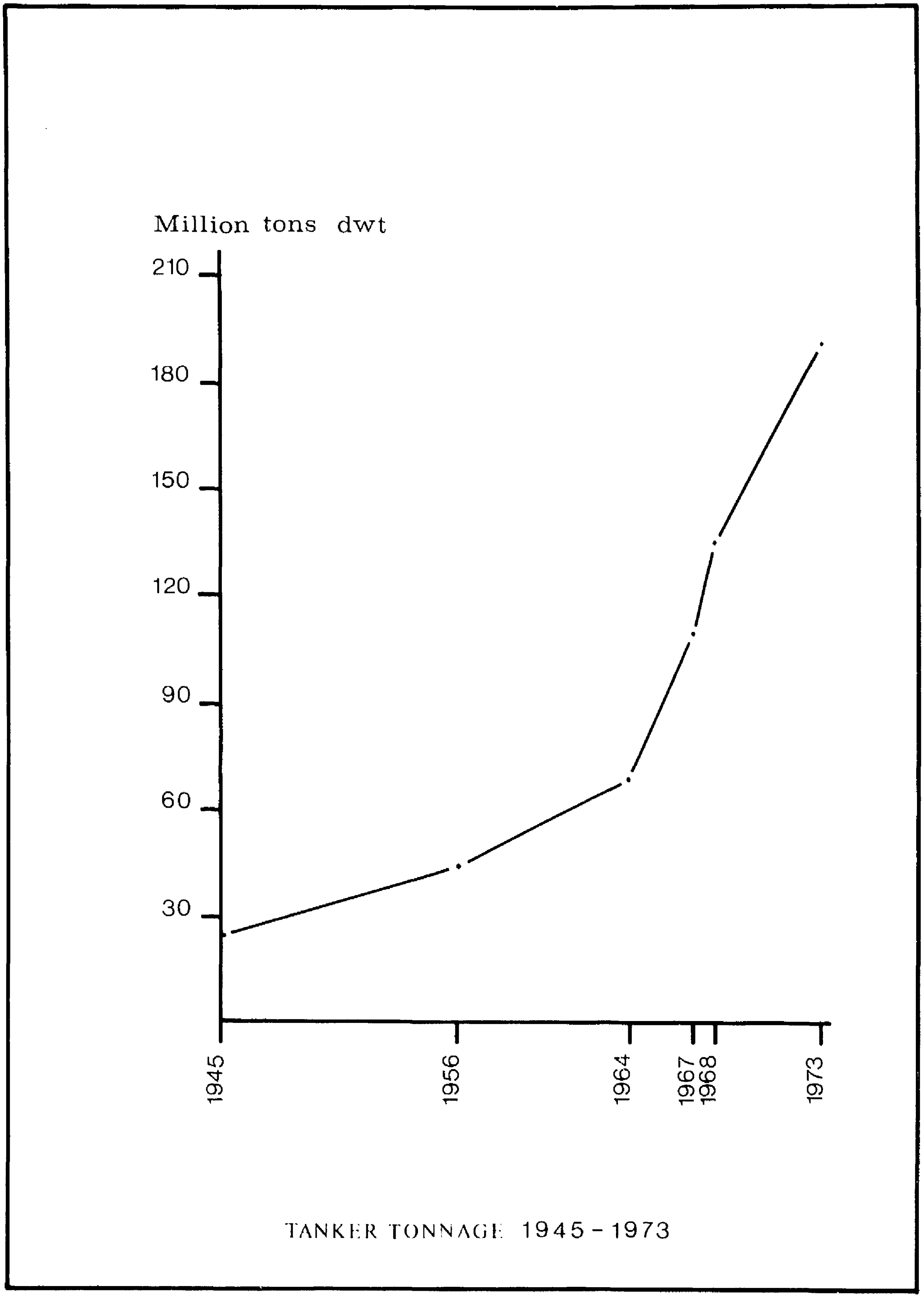

Fig. 1 - The increase in world tanker tonnage, 1945-1973.

Although orders for the 200,000 dwt. class have already been outnumbered by those for larger ships, there will be only 10 European ports able to accommodate ships of 200,000 dwt. fully laden. In 1969, 131 vessels of 200-250,000 dwt. were on order, and this decreased to 111 at the end of June 1970. However, over the same period, the number of 250-300,000 dwt. tankers on order went up from 56 to 95, and the number of 300,000 dwt. and over rose from 5 to 9. The following tables show tanker sizes, and tankers scheduled for delivery in the future.

Table 1 Summary of Tanker Sizes (end June, 1970)

Size Group dwt.	Existing Fleet*		Vessels on Order	
	No.	'000 dwt.	No.	'000 dwt.
10,000 49,000	2,182	55,823	135	3,448
50,000 - 99,000	644	44,736	21	1,676
100,000 - 149,000	102	11,792	29	3,702
150,000 - 199,000	31	5,501	9	1,589
200,000 - 249,000	82	17,509	111	24,632
250,000 - 299,000	2	507	95	24,855
300,000 and over	6	1,960	9	3,121
	3,049	137,828	409	63,022

* Oil companies and independent owners only. Government-owned tankers account for a further 128 vessels totalling 2.4 million dwt, and eight miscellaneous vessels for 0.1 million dwt.

Table 2 Scheduled deliveries of new buildings (end June, 1970)

Year	Tankers		Combined Carriers	
	No.	'000dwt.	No.	'000 dwt.
2nd half 1970	94	13,136	16	1,875
1971	156	21,614	43	5,926
1972	87	13,137	40	5,779
1973	57	11,477	18	3,122
1974	13	3,145		
1975	2	513		
	409	63,022	117	16,702

At present, the largest ship under construction is a 477,000 dwt. class tanker, which is over 100,000 tons bigger than the previous record holder at 372,000 dwt. The following table sets out the dimensions for this 477,000 tonner compared with some smaller giants.

Table 3 Tanker dimensions

	477,000 dwt.	372,400 dwt.	326,600 dwt.	210,000 dwt.
Overall length	1,243 ft.	1,133 ft.	1,133 ft.	1,065 ft.
Breadth	203 ft.	177 ft.	175 ft.	155 ft.
Draught	92 ft.	89 ft.	81 ft.	62 ft.

As the world tanker fleet is so vast, the flags under which it operates are many and varied. Liberia leads the world in terms of tanker registrations, and now almost $\frac{1}{4}$ of the world's tanker fleet trades under its flag. In second place is Britain, whose tonnage has increased greatly since the end of 1969. Close behind are Norway, Japan, and the U.S.A. Two-thirds of the world's tanker tonnage are accounted for by these five countries. Another country of importance is Greece, whose registrations have more than doubled between 1969 and 1970, and although Greek tankers fly various flags, the total tonnage controlled by Greece is 23.6 million tons, or 17% of the world fleet.

Table 4 Tanker Fleet Registrations*

	December 1969		June 1970	
	'000 dwt.	% of total	'000 dwt.	% of total
Liberia	30,784	23	43,461	25
U.K.	18,690	14	20,402	14.5
Norway	15,607	12	15,296	11
Japan	13,304	10	13,554	10
U.S.A.	8,901	7	9,213	7
Greece	5,744	4	6,528	5
France	5,087	4	5,549	4
Panama	5,210	4	5,424	4
U.S.S.R.	3,671	3	4,118	3
Italy	3,927	3	3,995	3
Netherlands	2,591	2	3,064	2
Sweden	3,120	2	2,489	2
Denmark	2,251	2	2,369	2
West Germany	2,531	2	2,307	2
Spain	1,996	1.5	2,099	1.5
Finland	806	0.6	1,017	0.8
Other	7,917	6	8,348	3
Total	132,137	100	140,323	100

* 10,000 dwt. and over, including government-owned and miscellaneous tonnage.

The source of the last four tables is Petroleum Press Service, October, 1970, pp.363-364.

The prevailing tendency in building tankers is to construct them with a capacity of not less than 100,000 tons. The motives behind constructing very large carriers are set out simply in the following.

Increased demand for oil:

It is believed that the European demand for oil will rise at a rate of about 8.5% per annum.[5] Various assumptions indicate that the expansion in the number and size of the European refineries would lead to increased import of crude oil. It is expected to rise from 367 million tons in 1966 to 511 million tons in 1970, and to 679 million in 1975. This would result in an increase in Middle Eastern and North African oil exports. Middle East exports, whether from the Gulf or the Eastern Mediterranean, are expected to rise by 68% between 1966 and 1975, while the figure for the same period in North Africa is 155%.[6]

The economic side of building large tankers:

As far as building a tanker is concerned, the cost of construction is not directly proportional to its size. The building cost per ton of the large tankers is attractive. A 200,000 tonner costs approximately $70 per ton, while a 100,000 tonner costs $92.4 per ton. For example, a tanker with 57,000 tons capacity would cost about $7 million, while the cost of building a tanker with 180,000 tons capacity would not exceed $14,700,000, i.e. for a ship three times as large, the cost is little more than double.[7] Also, shipyards provide subsidies for builders by charging them only 20% of the total cost in cash before the delivery of the vessel. The remaining 80% can be paid over 8 years at a current interest rate of 5.5 or 6%.[8] In 1965, the European Economic Community followed this example in its shipyards in order to enable it to meet Japanese competition.[9]

In spite of rapidly rising costs of construction, tanker prices do not seem to be increasing greatly. A 200,000 dwt. tanker ordered today for delivery in 1973-74 could cost a basic of $100 per ton.

Cost of operation:

Apart from costing comparatively less to construct, reduction in operating costs is another of the main arguments in favour of large tankers.

Running expenses do not rise in proportion to increase in size. Automation and technical advances in the engine room, and in loading/unloading have led to savings in the manning of very large tankers. For example, a carrier of 300,000 dwt. may require a total crew of 52 officers and men. A 75,000 dwt. tanker worked on the traditional methods may have as many as 56 crew members.[10]

Comparative cost of transporting oil by super-tankers

For the purpose of making a comparison between the different sizes of tankers and their costs, calculations made by Mr. W. Ashford, a London ship-broker, who based his cost figures on the tanker market situation before the closure of the Suez Canal and the devaluation of the £ sterling, were relied upon. To make the calculations, tankers of 80,000, 100,000, 200,000 and 300,000 dwt. were chosen. A vessel as small as 80,000 dwt. was included in order to be able to make a comparison of costs on the all-important Gulf/North Europe route in both directions, via the Suez Canal. The calculations concerning the larger tankers were based on journeys either loaded via the Cape of Good Hope and returning ballast via the Suez Canal, or in both directions via the Cape. It was also attempted to estimate freighting costs for the 500,000 dwt. vessels.

The first route taken was Mina al Ahmadi/Yokkaichi in Japan, one on which a straight comparison can be made for vessels of greatest beam without any artificial influence such as those which arise when the Suez Canal becomes the limiting factor.

Table 5 Cost of transport between Mina al-Ahmadi and Yokkaichi in Japan

Tanker dwt.	Cost per ton $	cents
100,000	2	34
200,000	1	54
300,000	1	37
500,000	-	98

Source: Petroleum Press Service, May, 1967, p.188.

The above figures demonstrate that although transport costs decrease rapidly to 200,000 tons (a difference of 74 cents) the rate of decrease diminishes as tanker size increases above that size of tonnage (a difference of 49 cents between the 200,000 and 500,000 tonners).

Between the Gulf and Western Europe, the all-important route on which the Suez Canal has so much influence, the calculations have been based on Mina al-Ahmadi/Rotterdam in Holland. The first five figures in Table 6 are based upon what may be described as the present normal or anticipated routing, via the Suez Canal both ways for 80,000 tonners, or via the Cape loaded and the Canal ballast for the 100,000 and 200,000 tonners, and via the Cape both ways for the 300,000 and 500,000 tonners. In addition, the 100,000 and 200,000 tonners have been calculated proceeding both ways via the Canal to show the difference it would make if the plans for deepening the Canal were carried out. (See Suez Canal.)

Table 6 Comparative costs of transporting crude oil from Mina al-Ahmadi to Rotterdam by various sizes of tankers and routes

Tanker dwt.	Routes	Cost per ton $	cents
80,000	Suez Canal both ways	3	83
100,000	Cape loaded - Suez ballast	3	50
200,000	" " " "	2	53
200,000	Cape both ways	2	70
300,000	" " "	2	33
500,000	" " "	1	85
100,000	Suez Canal both ways	3	39
200,000*	" " " "	2	82

* Assuming the Canal is deepened to take vessels up to 200,000 dwt.

Source: Petroleum Press Service, May 1967, p.188.

It can be seen from the table that the first five figures show a progressive reduction in the cost per ton. It also appears that using the 100,000 tonner via Suez both ways is slightly more economical than via the Cape loaded and Suez ballast. The reverse is true in the case of a 200,000 tonner. The reason is clearly the enormous figure for the Canal dues on the basis of current charges. (The Suez Authority charges about 88 cents per ton of crude oil.) This leads to the conclusion that there will need to be a major adjustment in the charges, to make the Canal route more attractive for large tankers.

In 1965, the Gulf Oil Corporation announced its intention of building six tankers of over 300,000 dwt.* to transport the crude oil from Kuwait via the Cape to Western Europe.[11] The primary factor in deciding Gulf to place orders for such giant tankers lay in the belief that the company could only compete with other companies if it was able to reduce the cost of transport. Reduction

* The deadweight capacity ranging between 312,000 and 326,000 dwt. The latter is mentioned by Kuwait Oil Co.

in the cost of transport could only be achieved by building larger tankers.

On October 29th, 1968, the first of these giants - Universe Ireland - made her maiden voyage from Kuwait to Gulf's new trans-shipment terminal at Bantry Bay in Southern Ireland.* Two days later, Universe Kuwait followed her sister ship to the same terminal.** These two vessels are the largest to date, each having a carrying capacity of 2,250,000 barrels. This amount is enough to run a refinery of 60,000 barrels per day for more than a month.[12] The cost of building each tanker was estimated at about $23.38 million.[13] It is believed that even with the capital investment in the Bantry Bay terminal and the additional cost of trans-shipment, these tankers would enable Gulf to transport oil around the Cape economically.[14] To illustrate the cost of transport from Mina al-Ahmadi to Bantry Bay via the Cape both ways, using the largest tankers, and then in smaller tankers to Rotterdam, the estimates are given in the following table.

Table 7 The breakdown of the cost of transporting oil from Mina al-Ahmadi to Bantry Bay, and then to Rotterdam, in tankers of varying sizes

Tanker dwt.	Cost per ton $	cents
Mina al-Ahmadi/Bantry Bay		
300,000	2	21
500,000	1	75
Bantry Bay/Rotterdam		
80,000	-	52
100,000	-	57
Storage and trans-shipment to Bantry Bay	-	35
Mina al-Ahmadi/Rotterdam via Bantry Bay		
300,000 + 80,000	3	09
300,000 + 100,000	3	04
500,000 + 80,000	2	62
500,000 + 100,000	2	57

Source: Petroleum Press Service, May, 1967, p.188, and December, 1968, p.451.

* See the receiving points.

** Both vessels were built in Japan: the Universe Ireland at Ishikawajima Harima's Yokohama yard, and the Universe Kuwait at the Nagasaki yard of Mitsubishi Heavy Industries. The two shipyards are also sharing equally in the building of the other four vessels. Each vessel has a length of 1,135 feet, and needs a water depth of 79 feet.

Comparing the above figures with those in Table 6, it may be seen that the above costs are lower than those incurred when shipping direct from Mina al-Ahmadi to Rotterdam in 100,000 tonners, and more costly than doing so in 200,000 tonners. This means that advantages can be obtained only where ports are unable to handle ships larger than 100,000 tons.

However, companies have differing opinions on the cost of transporting oil from the Gulf to Rotterdam. To give an example, Esso, which has 14 vessels of around 250,000 dwt. under construction, estimated the costs per ton at about $2.95 or 24/6d. Shell puts the rate for a 200,000 tonner using the cape both ways at approximately $3.36.[15]

It would appear that Gulf Oil Corporation is making substantial profits from using the mammoth tankers (326,000 dwt.) and the Bantry Bay trans-shipment terminal. This may be noted from the words of Mr. P.B. Binstead, President of Gulf Oil Transportation. He said, "Although, clearly, it will be some time before we are able to chronicle the precise economics, we certainly are confident that cost per barrel of bringing oil from Kuwait by the mammoth tankers is roughly one half as much as Gulf's cost of moving the oil through the Suez Canal in the largest vessels that could transit the Canal prior to its closure."[16]

The economics of using the big ships are attractive, and it is true that operating costs in general decrease as tankers increase in size. But at the same time they bring with them some disadvantages which are summed up in the following points.

1. The limitation of the water depth at the loading and unloading points, as well as en route. Greater draught might necessitate longer shipping routes and trans-shipment, which immediately raises the question of the cost of secondary distribution.

2. Sufficient facilities at terminals: the larger the tonnage delivered in one ship the larger the storage tanks must be, the greater the capacity of the pipelines, and the larger and stronger the piers.[17]

3. Lack of repair facilities along the route to Europe. There are plans for large new dry docks in South Africa and Iran, but so far there is no confirmation that these will be able to handle a tanker of over 300,000 tons.

4. The concern about the large amount of crude oil at risk in a giant tanker such as a 500,000 tonner if it failed to arrive for any reason.[18]

5. Although reductions are obtained in the cost of transportation by employing large tankers, the insurance rates have moved rapidly in the opposite direction. Insurance for the big tankers has proved to be proportionately dearer than for the smaller ones, and the annual premiums are anything from three to four times as much as those of a few years ago. To illustrate this, a tanker of 200,000 tons, valued at $20 million, would have cost less than $500,000 a year to insure at the end of 1969, and by the middle of 1970 it could cost as much as $700,000 (about 3½% of the insured value), and the owner is liable for the first $25,000 of any claim.[19]

2. Receiving Points

A major problem of employing large tankers concerns the facilities at ports and terminals where they load or discharge the oil. In the whole of Western Europe there is only one port which can accommodate tankers of over 300,000 tons, and a very few which are capable of taking vessels in the 200,000 to 250,000 dwt. class without difficulty. Therefore deeper terminals is not the only problem, another is lack of land and storage facilities sufficient to take the cargo of giant tankers. Thus the development of ports suitable for these tankers is extremely costly.

The need for improvementof port facilities is greatest near the vast refining centres of Western Europe and Japan. In 1969, Europe and Japan received more than $\frac{3}{4}$ of all crude oil shipped from the Gulf.

The pressure for urgent development was urged by the amount of money lost by the inability of the mammoth tankers to operate to their maximum efficiency. From a study carried out on tanker voyages from the Gulf to Western Europe, it is revealed that of 107 voyages, only 31% were made on the basis of one loading port and one discharge port, and 23% on the basis of two loading ports and discharge ports (or one port after a ship-to-ship transfer). The average voyage time was 5 days longer in the latter case than that spent on one-to-one port movements. According to the study, if all of these voyages were performed on the one-to-one port basis, the total time saved would have been some 250 days. The cost of these extra days would have been $62,440 per day, which amounts to a total of about $16.24 million.[20]

The serious limitation in employing the super-tankers to their maximum efficiency appears to be water depth. A fully loaded 100,000 dwt. tanker needs about 47 ft. of water. This rises to an average of 55 ft. for 150,000 dwt., 61 ft. for 200,000 dwt., 66 ft. for 250,000 dwt., 73 ft. for 300,000 dwt., and about 90 ft. for 367,000 dwt. Apart from this, a further 10-20% of the ship's draught must be added to provide safe navigation at all times.

In order to utilise the capacity of a mammoth tanker on its voyage from the Gulf to Europe, the oil companies have two alternative methods, i.e. trans-shipment or partial unloading. The Bantry Bay terminal which was built especially to receive Gulf's 326,000 dwt. tankers is an example of the first method. Gulf transport oil from Kuwait to Bantry Bay, from where it is re-distributed to other ports in smaller tankers. (At present, Bantry Bay is the only terminal which is not linked directly to a major refining centre). Partial unloading permits the giant tankers to use ports of limited water depth. For example, a fully loaded tanker of 210,000 dwt. with a maximum draught of 63 ft. needs a water depth of 54 ft. if its cargo is lightened to 175,000 tons and 52 ft. for 170,000 tons. Similarly a 253,000 dwt. vessel when fully loaded has a draught of 66 ft., but will draw only 57 ft. of water when carrying 210,000 tons of crude oil. Shell pioneered the use of lightening operations. However, it is simpler for a mammoth to offload partially at a deep-water terminal and then proceed to a secondary port with the remainder of its cargo.[21] Although this can be done safely with no leakage of oil, there are disadvantages, the greatest being the necessity of timing tanker meetings at sea under appropriate weather conditions, which is comparatively difficult against the strafghtforward docking of a crude carrier in port. However, the economic advantages of using mammoth tankers are obviously limited by these systems, and can only be regarded as temporary measures while the gap between tanker and terminal sizes is being closed.

With regard to this problem, nearly every port in Europe is in the throes of providing or planning harbour work to give access to the big tankers. In some cases, all that is required are bigger, stronger berths, increased storage and handling facilities on shore, and possibly the dredging of a short approach channel for the mammoths. This is only where there is a natural deep-water harbour, however, and in the absence of this, there are two alternatives. One is dredging, which is expensive and impermanent, and the other is to construct an offshore mooring point, linked to the coast by a submarine pipeline. The latter is often a more attractive proposition. The table below shows European ports with regard to mammoth tankers, and the year each became capable of receiving such vessels. (See also Fig. 2.)

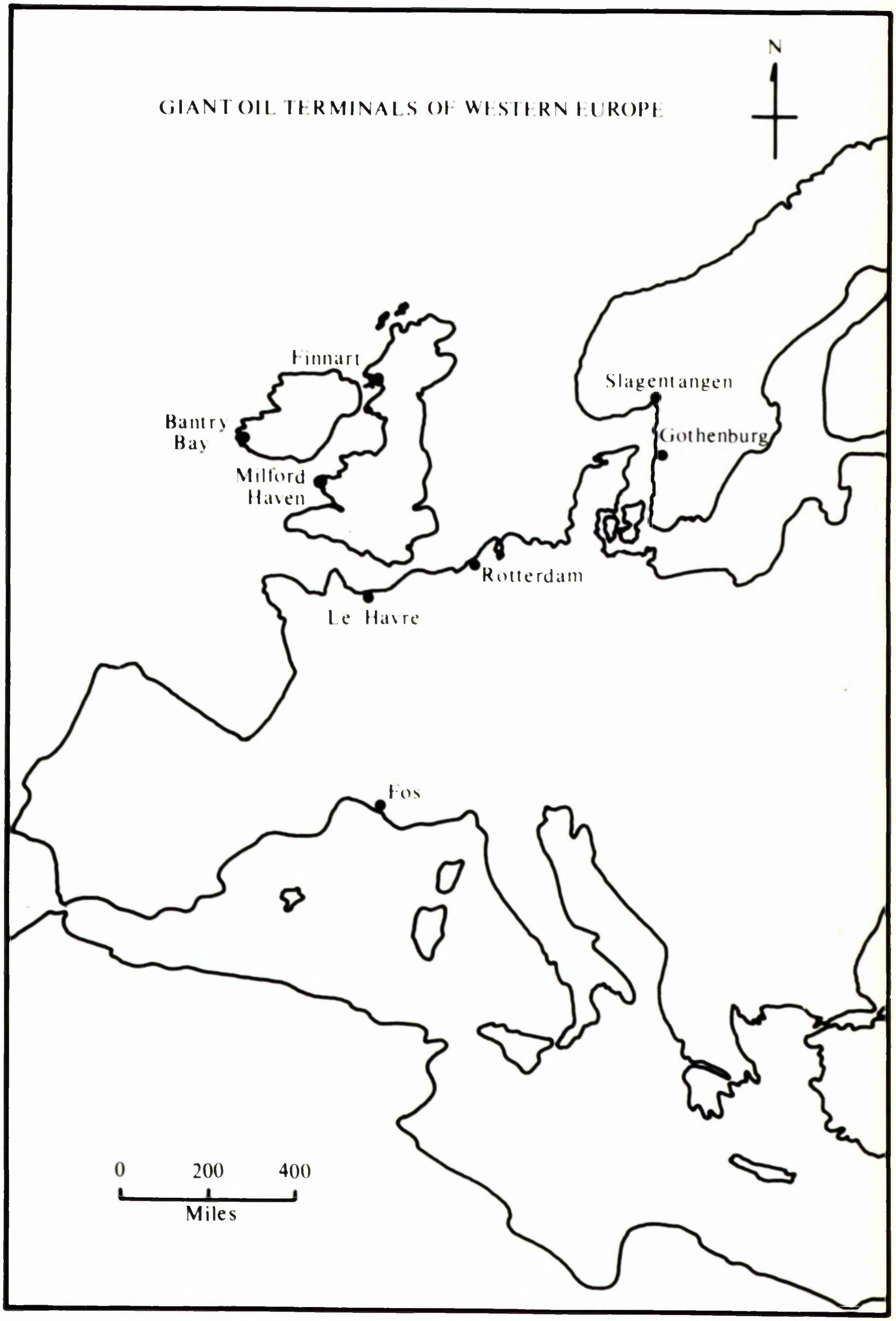
GIANT OIL TERMINALS OF WESTERN EUROPE
N
Finnart
Bantry Bay
Milford Haven
Slagentangen
Gothenburg
Rotterdam
Le Havre
Fos
0 200 400
Miles

Fig. 2

Table 8 Ports in Western Europe which can accommodate mammoth tankers

Ports	dwt. of individual tankers	Year of port modification
Rotterdam (Holland)	250,000	1970
Bantry Bay (Ireland)	500,000	1968
Gothenburg (Sweden)	250,000	1969
Slagentangen (Norway)	250,000	1968
Milford Haven (Wales, U.K.)	250,000	1970
Finnart (Scotland, U.K.)	200,000	1969
Fos (France)	250,000	1969
Le Havre* (France)	300,000	1970

* The authorities at this port have already planned an artificial island off the port's entrance to accommodate 500,000 tonners.

Source: Petroleum Press Service, December, 1968, p.452 and October 1969, p.371.

From the above table it is plain that only one port was suitably equipped to receive tankers of 250,000 tons in 1968, although tankers of 300,000 tons dwt. were in operation at that time. Therefore tankers of 200,000 dwt. had to enter these ports only partly loaded, which defeated the point of building large tankers in the first place. Most of the development of these ports has taken place between 1969 and 1970.

Two examples will be analysed here, one being Rotterdam, because of its geographical position in Europe and also because of the many refineries there. The other, Bantry Bay trans-shipment terminal, which has been taken because it is the first of its kind in the world.

Rotterdam

Although it is anticipated that the Europort will be handling more than 196.8 million tons of general bulk cargo yearly by 1972, at present over 177 million tons are handled on their way to serve the continually expanding markets of Holland and Landbound Europe. Of this, about 98.4 million tons is crude oil. Many of Europe's major industrial areas are within 300 miles of Rotterdam, as are the population centres including London, Amsterdam, Antwerp, Bremen, Hamburg, the cities of the Ruhr, and Frankfurt. These cities have about 160 million people, and a wide range of industries. Apart from refineries and storage facilities, the Europoort has shipyards capable of building and repairing ships of 250,000 tons dwt.

In the harbour area at Rotterdam, which is Europe's largest oil refining and petrochemical centre, and one of the world's largest, there are five major refining complexes. These belong to Shell, Caltex, Esso, British Petroleum, and Gulf, and have a combined crude capacity of 65 million tons per year. B.P.'s Europoort refinery was finished in 1967 and has a capacity of 5 million tons per year. However, by 1971, the capacity will rise to 14 million tons a year, which would make it the largest refinery owned entirely by B.P., having cost about $121.6 million. Of the products, about $\frac{1}{4}$ is exported over the refining jetties, another $\frac{1}{2}$ is piped about 9.3 miles to the B.P. terminal in Germany at Bottlek for distribution by road, rail, and barge. The remaining $\frac{1}{4}$ is pumped into terminals at Dormagen, Karlsruhr, Offenbach, Stuttgart, and Ludwigshaven, through the 350 mile long Rhine-Main-Ruhr (RMR) pipeline.[22]

Another Rotterdam/Rhine pipeline is owned jointly by Shell, Caltex, and Mobil/Gelsenberg interests and was completed in 1960. Its ultimate carrying capacity is 20 million tons per annum. A third pipeline is planned to commence operations between the Europoort and Antwerp late in 1971. In 1968, at nearby Amsterdam, Mobil finished a 4 million ton plant, but as there are no facilities there to accommodate the largest of the super-tankers, it has been decided that a new 28 inch pipeline from Rotterdam harbour will supply both this and any future refineries in Amsterdam.[23]

Until recently, it was considered that the Europoort offered the best tanker facilities in Europe, but doubts about its future have now been expressed. Before dredging, the port was able, in 1967, to accommodate tankers of up to 165,000 dwt. After dredging and deepening the channel, it can now take tankers of 250,000 dwt.[24] Although in the past the dredging of channels was expensive, difficult, and largely based on guesswork, in recent years, because of experiments carried out on models, it has become possible to situate channels where less maintenance and dredging are needed. However, it still cannot be regarded as a cheap process. For example, the cost of dredging a deep water channel, 12 km. long off the Hook of Holland has been estimated at $19.6 to $28 million.[25]

Bantry Bay

The inauguration of Gulf's transhipment terminal at Bantry Bay in Southern Ireland in 1968, came at a time when various European ports were preparing to accommodate the very large tankers of about 200,000 dwt. Bantry Bay is one of the only two terminals in the world at present capable of handling tankers of over 300,000 dwt fully loaded. The other is Mina al-Ahmadi in Kuwait as mentioned previously. The motives behind constructing such a terminal were firstly, that at the time, Gulf was facing severe competition from other oil companies in Western Europe. Secondly, because of the geographical spread of Gulf's refineries in Western Europe, i.e. at Europoort, Holland; Stignaes, Denmark; Milford Haven, U.K.; and Huelva, Spain.

Thirdly, the relative smallness of these refineries made the use of very large tankers uneconomic.[26] Gulf's answer to these problems was to build a huge trans-shipment storage terminal as near as possible to the Company's European refineries, and able to accommodate large tankers. As put by a Company spokesman "to create a giant man-made oil field close to the Company's market."

In order to find a suitable location for the proposed terminal, during 1965 and early 1966, Gulf examined numerous deep-water locations around the coast of Western Europe. A site was finally chosen on Whiddy Island, in Bantry Bay, south-west Ireland. (See Fig. 3.) This site had all the requirements for which the Company was looking. It had access to deep water (100 ft. at a distance of 1,200 ft. from the shore). It was also capable of receiving, unloading, and dispatching tankers in any weather at any time of the year. As well as the above factors which recommended it, the site was conveniently placed for Gulf's European refineries.[27] The only difficulty with which the Company was faced in building the Bantry Bay terminal was the sea-bed. The terminal's sea-bed covers folded strata of slate and grey-green sandstone. These strata strike from east to west and dip vertically. Cracks in the rocks have been caused by erosion and on top of these there is a layer of boulder clay left behind by the Ice Age. The depth of this clay varies from 5 ft. at the western end, to 40 ft. at the eastern end of the island. These conditions necessitated the use of floating equipment rather than jack-up barges.[28]

On Whiddy Island, which is almost three miles long and one mile wide at its widest point, work started in December, 1966. * On the Island

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* About one-third of Whiddy Island is owned by Gulf and the terminal occupies less than one-quarter of it.

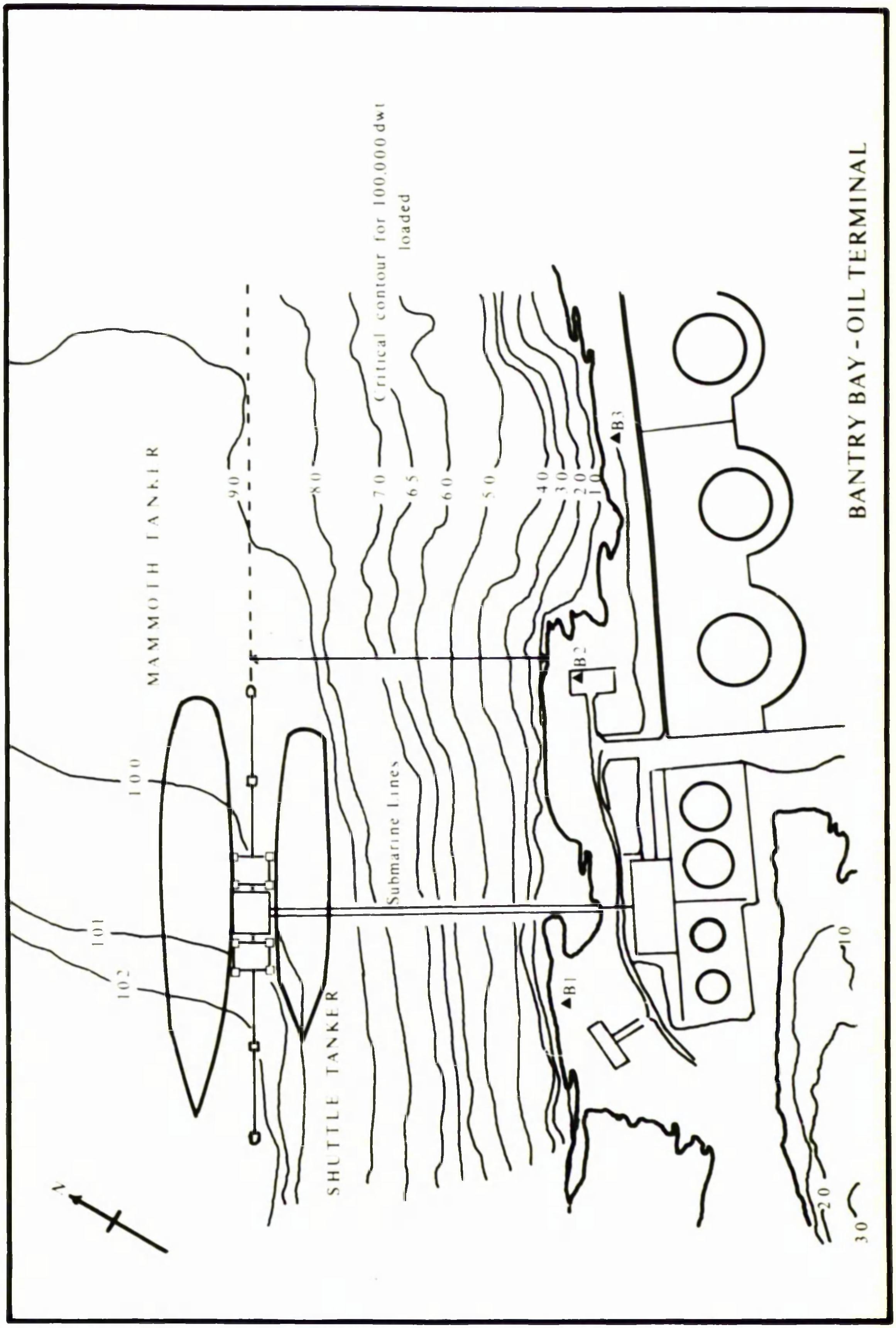

Fig. 3 - A sketch showing the water depth contours at Bantry Bay terminal. (Depths in feet)

there are 12 x 600,000 barrel storage tanks, giving a total storage capacity of 7.2 million barrels, or approximately one million tons. In addition there are 2 x 100,000 barrel tanks for the storage of bunker fuel, and 2 x 500,000 barrel dirty ballast tanks. Two 42" submarine crude oil lines link the tank farm on the Island and the offshore jetty at which all the tankers berth.* Both of these lines are used for unloading the over 300,000 ton tankers and for loading smaller "shuttle" tankers. In addition there is 1 x 30" dirty ballast line, 1 x 18" bunker line, 1 x 8" firewater line, and 2 x 10" diesel lines.

On the unloading berth there are four unloading arms of 16" diameter, which enable the terminal to receive crude oil at a rate of up to 100,000 barrels per hour. On the loading berth there are four loading arms each of 12" diameter which allow for the maximum loading rate of 80,000 barrels per hour. All these loading/unloading arms are connected to the two 42" diameter submarine pipelines.

The terminal can accommodate only two tankers at one time. The outer, or North berth, where the minimum depth of 100 ft. of water is available, is used by the 326,000 dwt tankers. The inner berth which has a water depth of over 90 ft. is used by the smaller shuttle tankers (ranging in size between 80,000 and 100,000 dwt). See Fig. 3.

Tidal streams and currents at the terminal are virtually non-existent, and rarely cause berthing problems. Surface currents can of course be generated by the prevailing winds which are predominately from the south-west to west.

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* The offshore terminal is located 1,200 ft. from the Island, with simultaneous mooring for mammoth tankers on the north side, and shuttle tankers on the south side. The berthing facilities on each of the two berths consist of four breasting dolphins and four mooring dolphins.

The force of the wind, wave height and swell conditions are the limiting weather criteria for berthing vessels, and although some delays are envisaged, particularly in the winter months because of weather, it is not anticipated that these will be of long duration or unduly affect the operation of the terminal.[29]

It appears that Gulf has pioneered a useful idea with this scheme, as in November 1968 Shell signed a contract with them for the use of Bantry'Bay's trans-shipment facilities by Shell's 200,000 class ships, if and when trans-shipment there is required. When fully loaded, these 200,000 tonners cannot enter the ports serving Shell's refineries, and so they have to offload some of their cargos into 70,000 tonners at sea.

The latest addition to the list of mammoth tanker ports in Europe is Bilbao, where Gulf-Petronor Group is to build a refinery with a capacity of 5 million tons a year. At this terminal the Group will provide facilities for vessels of up to 500,000 dwt.[30]

The methods used to safeguard competitiveness in Europe apply elsewhere. At Okinawa, Gulf is building a trans-shipment terminal similar to Bantry Bay, which will be supplied by mammoth tankers, and which will feed the Company's Far Eastern markets.[31]

Gulf also has a project in Nova Scotia - "Point Tupper" - where it is intended to build a terminal for ships of 300,000 dwt. and over, as well as a refinery. This project will give the Company the benefit of not having to trans-ship all the cheaply freighted crude oil.[32]

In conclusion, it is to be said that the use of trans-shipment terminals offers many advantages. It means that even refineries whose port facilities cannot cope with the giant tankers will reap their operating advantages.

3. Suez Canal*

Since the major markets for Middle Eastern petroleum are located west of Suez, the greater part of exports to those markets moved through the Canal until its closure in June, 1967.

The Suez Canal (See Fig. 4) was completed in 1869, with a depth of 26 ft., but projects for deepening and widening the Canal have been in operation in recent years. Until 1956, the Canal could only take ships with a draught of 35 ft., but this was increased to 38 ft. in 1966. The increasing volume of exports of petroleum to countries west of Suez raised the question of the Canal's capacity to handle an additional number of tankers together with tankers of large size; 200,000 ton tankers for example, need a water depth of 60 ft. In this connection, plans to deepen and widen the Canal were made by the Suez Canal Authority. These provided for the draught to be increased from 38 ft. to 40 ft. by the end of 1967. This was to be followed by two ambitious projects to increase the draught to 48 ft. by the end of 1972, and to 57-58 ft. by the end of 1975. In the second project, consideration was also given to plans to permit tankers of 62 ft. draught fully loaded except for the 326,000 tonners which have a draught of 72 ft. The draught of a 500,000 tonner, if built, would probably be about 85 ft.[33] The first of these plans was approved by the Egyptian Government.

Naturally the cost of all this work would have been immense. Deepening the Canal by one foot would cost more than $42 million, as the Canal is

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* A concession to build a canal linking the Mediterranean and Red Seas was granted to Ferdinand De Lesseps in November, 1854, Work began on the Canal in April, 1859, and it was officially opened in November, 1869. In 1888, the Suez Canal Convention was signed at Constantinople by all the great powers. It provided for free and open passage in time of war and in times of peace, for all vessels. This right was denied to Spanish vessels in the Spanish-American War of 1898, to German vessels in the two World Wars, and to Israeli vessels by the Egyptians since 1948. In July 1956, the Egyptian Government nationalised the Canal, although the Suez Canal Company's concession did not expire until 1968.

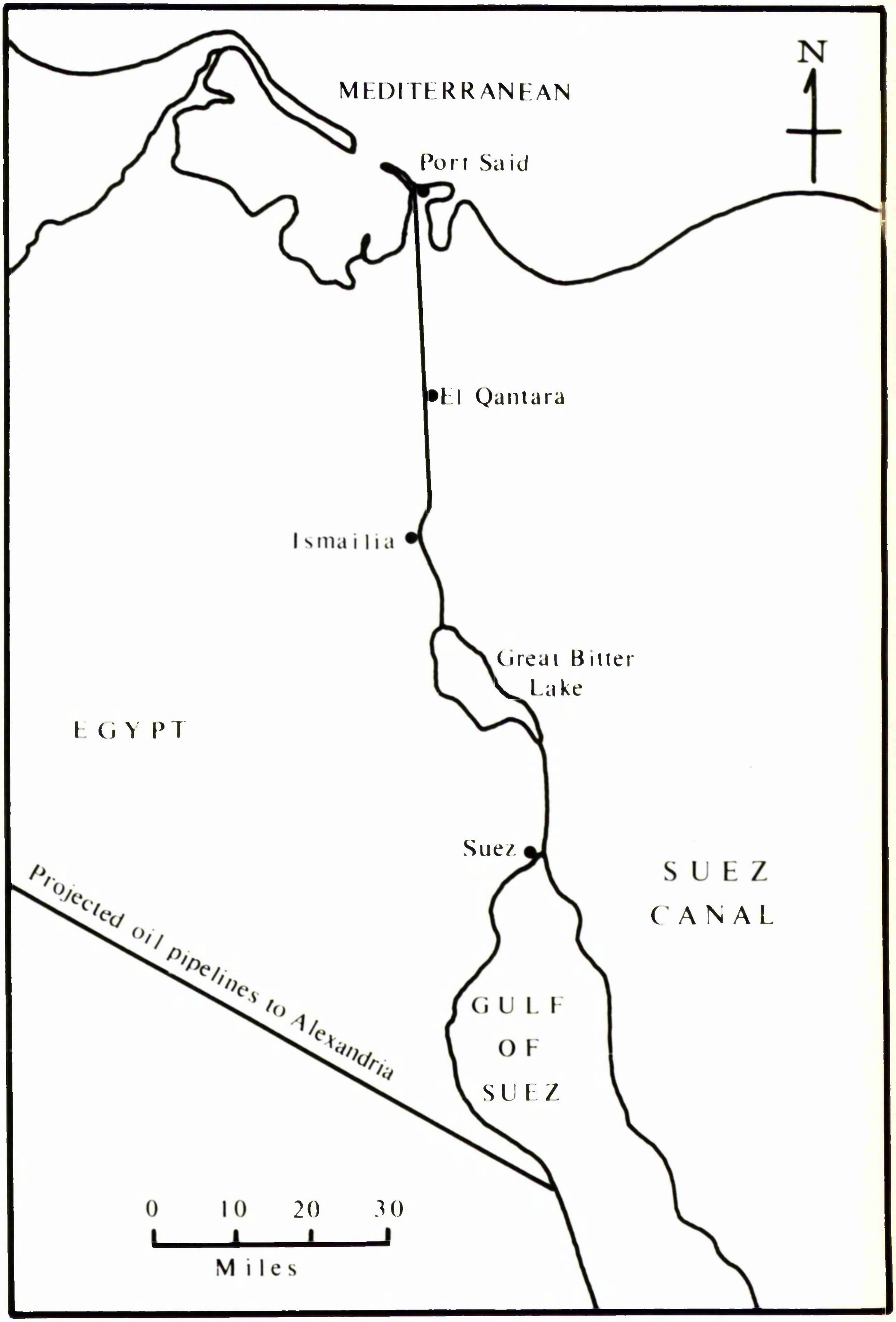
MEDITERRANEAN
N
Port Said
El Qantara
Ismailia
Great Bitter
Lake
EGYPT
Suez
SUEZ
CANAL
Projected oil pipelines to Alexandria
GULF
OF
SUEZ
0 10 20 30
Miles

Fig. 4

107 miles long (including approach fairways) and has a maximum width of 660 ft. (minimum 600 ft.)[34]

The journey from the Gulf to the United Kingdom through the Canal takes about 17 days, compared with 30 days by the Cape route (round Africa). The route from Kuwait to the United Kingdom round the cape is 11,636 nautical miles. Thus the Canal route, which reduces the distance to 6,700 nautical miles, is considerably shorter, both in time and in distance.[35]

The Suez Canal dues in 1956 stood at 96 cents per short ton in cargo, and 44 cents per short ton in ballast. In 1964, the Canal Authority increased the dues by imposing a general surcharge of 1% over the existing rate. Also they demanded an additional 2% surcharge for every foot or fraction of a foot in excess of 37 feet from vessels whose draught exceeded this. Since then, the Canal dues have been increased twice, first on 1st July, 1965, and second on 1st July, 1966. In early 1967, Canal dues stood at $1 per short ton in cargo, and 45 cents per short ton in ballast. The increase and the surcharges were justified by the Canal Authority on the grounds that wages and prices were rising, and that some rise in gross revenues became essential if the Canal was to be enlarged. This increase in dues only slightly raised the cost of using the Canal. In INTASCALE (The International Tanker Nominal Freight Scale), 87 cents per ton of oil carried was the payment allowed for in the cost of using the Canal in a round trip. This comprised 59 cents for the South/North Journey loaded, and 28 cents for the return journey in ballast, and even after the increases had taken place, this figure was not altered.[36]

In the varied history of the Canal there have been two crises. The first was in 1956, and was resolved. The second took place in 1967, and has not yet been settled.

The Suez Crisis of 1956

It is not proposed to deal here with the reasons for the Suez Crisis, or to apportion blame to one side or another. It is intended to discuss the effects of this crisis on the oil industry.

The Anglo-French invasion of Egypt led to the blocking of the Suez Canal by the Egyptians on October 31st, 1956. Although Egypt's action did not aim specifically at oil enterprise, it was bound to affect the oil traffic which constituted a large part of the total tonnage passing through the Canal. In fact, oil amounted to 65% of this tonnage. It should be borne in mind that the blocking of the Canal was accompanied by another act of sabotage in the Arab world. This was directly aimed at the oil industry, and it affected the economy and security of Western Europe very badly. On November 2nd, 1956, all three pumping stations of IPC's pipeline in Syria were blown up, and the flow of oil from Iraq to the Mediterranean terminals at Banias and Tripoli was stopped.* The following passage elaborates on the effect of the blockade and sabotage on the oil industry in Western Europe.

In actual figures, the position was that 102 million tons of oil passed through either the Canal (77 million tons) or Syrian pipelines (25 million tons) every year, and this traffic was halted entirely. Of this yearly total of 102 million tons (2.04 million barrels per day), 87.5 million (1.75 million barrels per day) were destined for Europe, which was importing oil at a rate of 125 million tons yearly (2.5 million barrels per day) in 1956. Therefore, in the period after the invasion, Europe was 70% short of its usual total oil supplies.

However, the oil which would normally have gone via the Canal could be shipped around the Cape, although the delay of roughly 2 weeks meant that

* On December 20th, 1956, Syria allowed IPC's engineering team to inspect the pipelines, and on March 6th, 1957, (four months after the stations were blown up), official permission to start repairs was given.

supplies amounted to barely 60% of the usual Suez oil traffic. Thus Europe was bound to be short of at least 45% of its normal supplies, and even this figure is based on the assumption that all the oil being directed via the Cape was to be delivered to Europe, whereas before the blocking of the Canal, 20% had been destined for the Western Hemisphere, and only 80% for Europe.

As the European countries were highly industrialized it is plain to see that the damage done to their economies was substantial. Their governments turned to other sources of supply, mainly in the Western Hemisphere. However, this was not easily accomplished, as supplies were demanded at very short notice, making them difficult to obtain. Also, the amount of tanker space available for transportation was limited. The governments found too, that obtaining oil this way was proving a drain on their hard currency resources

It could be said that the Suez Crisis of 1956 gave the countries of Western Europe food for thought regarding oil transportation. For many years before the Suez Crisis, the oil industry had recognised both the technical and economic advantages of employing large tankers, but not many were built for the Middle East/Europe oil trade. This could be related to several factors, among which are:

(a) A lack of sufficient ports, terminals, and docks at which large tankers could be handled.

(b) Importing large quantities of oil necessitated alterations in the size of the refineries and storage tanks as they had limited capacities. This entailed the engagement for long periods of large amounts of capital, in stock-piling oil.

(c) The Canal also presented an obstacle of its own in its limited depth.

The closure of the Canal obviously changed the situation, and then it was realised that small tankers, or even those of medium size were proving disadvantageous when used on the Cape route. Accordingly, the number and sizes of terminals, ports, and repair docks were increased to accommodate larger tankers. Also, large sums of capital were spent on enlarging the capacity of refineries at home.

Apart from the above factors, the Canal became undesirable as an oil route to both European consumers and the Western Oil companies engaged in oil operations in the Middle East. The European countries also adopted a policy of reducing their dependence on Middle Eastern oil, by obtaining oil from other parts of the world, such as North Africa, Nigeria, Alaska, and other places.

The Second Closure of the Canal - June 1967

In the first week of June 1967, the Canal was closed for the second time as a result of a war between Egypt and Israel. The Egyptian Government then declared that navigation through the Canal would be resumed only when the Israelis withdrew from the Eastern bank of the Canal which they occupied during the war. As a result, the Canal has remained entirely shut, since then, with 15 vessels trapped inside. Since the cease-fire, negotiations regarding a settlement in the Middle East have taken place between the Four Powers (U.S.A., U.K., U.S.S.R., and France), but unfortunately nothing has yet been revealed.

In contrast to that of 1956, the second closure of the Canal did not have much effect on world oil supplies. In 1956, the production of oil in the Middle East was also considerably hindered by an insufficient number of tankers to move the produced oil to Western markets via the Cape, while in 1967, a tanker capacity of 3.5 million tons was engaged in grain trade or laid up due to lack of employment when the Canal was closed. Apart from the existing tanker tonnage (which amounted to 99.4 million dwt. in 1966) new delivery of 3.065 million dwt. was made in the first half of 1967, and an estimated 6 million dwt. was to be added to world tanker tonnage in the second half of the same year.[38] Thus, the freeing of tankers from the grain trade, together with the available tanker tonnage, prevented a shortage of oil supplies to Western Europe.

Like the first crisis, the second had various results, among which was that demands for tanker tonnage were increased.* This increase was accompanied by higher freight rates not only on the Gulf/Europe route, but also on all other oil routes in the world. During the first month of the closure of the Canal, single voyage rates for the Mina al-Ahmadi to U.K. run had increased from $3.27 per ton of oil carried via Suez and including dues at the end of May, to $20.2 per ton carried via the Cape at the end of June. Similarly, single voyage rates rose in the Caribbean from $1.75 per ton of oil before the Crisis, to $7.81 in June.[39] The re-routing of oil traffic from the Canal to the Cape during June-September was not the only cause for the rise in tanker rates, another was the need to ship extra amounts of oil from the Gulf to Europe in order to compensate for the loss of the oil which was normally available at Mediterranean terminals. It is also to be mentioned that after the June war, oil supply from Libya was completely stopped until the first week of July, and the supply from Saudi Arabia's Tapline was not resumed until the third week of

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* B.P. was the first major oil company to charter tankers after the crisis. On 10th June, 1967, B.P. chartered tankers totalling 800,000 tons for up to two consecutive voyages round the Cape at $8.40 a ton, or nearly double pre-crisis rates. On the 17th of the same month, B.P. chartered another $1\frac{1}{2}$ million tons, again for two consecutive voyages around the Cape, lasting about three months in all. At the same time, a tanker was booked for a single voyage from the Gulf to Portugal at $26.88 per ton. (The Economist, June 24th, 1967.)

September. The governments of both Libya and Saudi Arabia had demanded an increase in the posted prices at Mediterranean terminals from their respective companies. This was because the relative advantages of freight savings had increased due to the Canal closure and the resultant rerouting of Gulf oil around the Cape.[40]

In conclusion, the Canal's closure lengthened the trade routes from the Gulf to Europe, increased freight rates and presented higher prices of petroleum products in many countries. Also, the Canal is now no longer regarded as a safe route by the shipping industry.

4. a. Oil transportation by pipelines

Decisions in building pipelines are dictated by sheer necessity. Apart from a short distance gathering system which is essential in all oil fields, it is also possible to build long distance pipelines to transport oil in large quantities from inland oil fields to shipping points, refineries and other distribution centres.

From the map (Fig. 5) it becomes obvious that the most sensible way to move Gulf oil is direct to the Mediterranean, from where it is not far to the markets. The only disadvantage of this route is that the pipeline has to pass through several countries. This is alright as long as politics do not enter into the situation.

Both Iraq Petroleum Pipelines (IPC) and the Trans Arabian Pipeline (Tapline) are regarded as being among the largest crude oil pipelines in the world. IPC's pipelines transit crude oil from the Iraqi oilfields in the north, to the Mediterranean at Tripoli and Banias. As is shown in the table below, several lines of different sizes move the produced oil. In the case of the Tapline, the oil is transported from the eastern section of Saudi Arabia (Gulf Region) to Sidon, the Lebanese port on the Mediterranean.

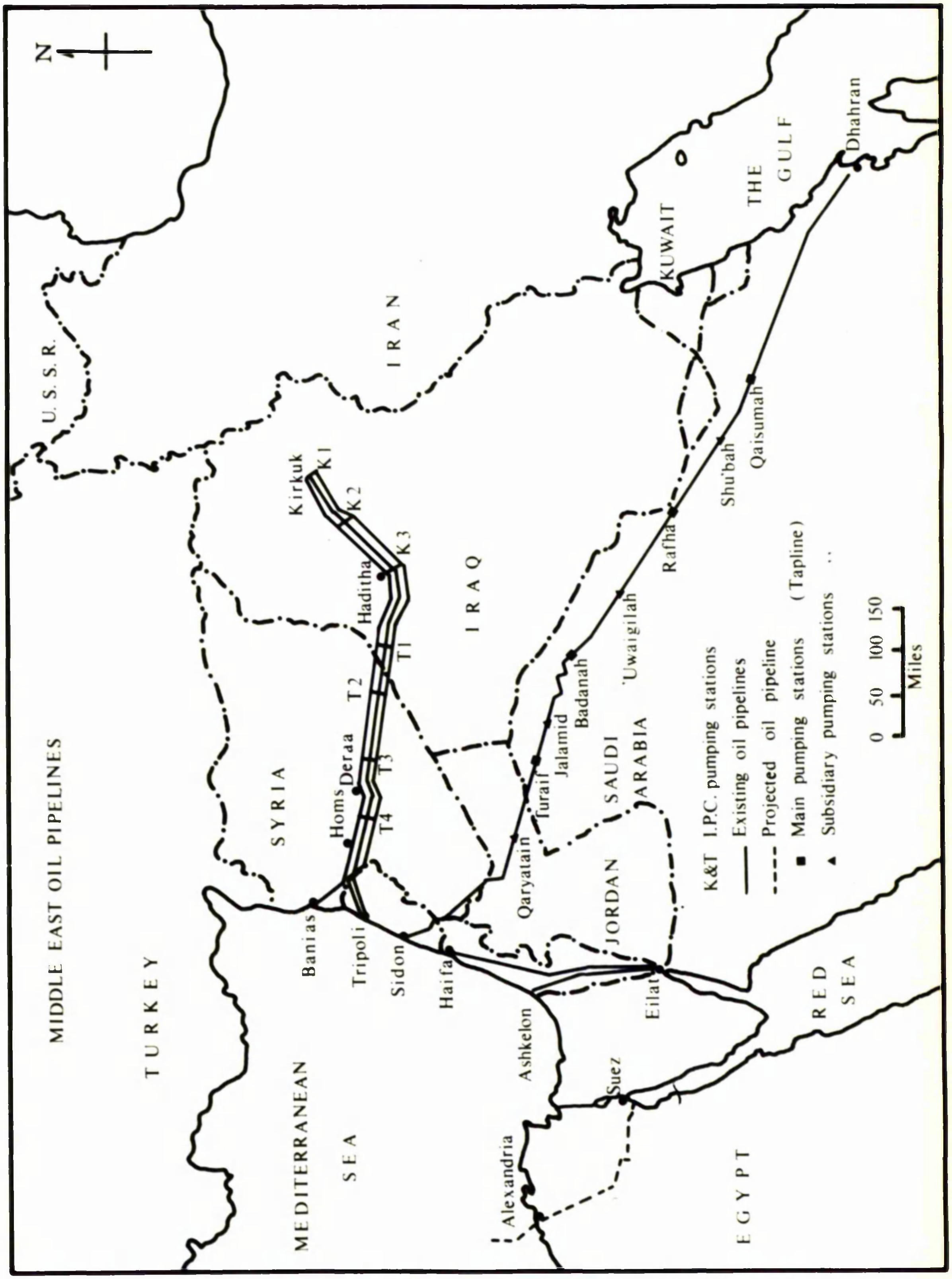
MIDDLE EAST OIL PIPELINES
N
TURKEY
U.S.S.R.
IRAN
SYRIA
IRAQ
MEDITERRANEAN
SEA
SAUDI
ARABIA
JORDAN
KUWAIT
THE
GULF
RED
SEA
EGYPT
Kirkuk
K1
K2
K3
Haditha
T1
T2
Deraa
T3
Homs
T4
Banias
Tripoli
Sidon
Haifa
Ashkelon
Eilat
Suez
Alexandria
Qaryatain
Turaif
Jalamid
Badanah
'Uwaigilah
Rafha
Shu'bah
Qaisumah
Dhahran
K&T I.P.C. pumping stations
Existing oil pipelines
Projected oil pipeline
Main pumping stations (Tapline)
Subsidiary pumping stations ..
0 50 100 150
Miles

Fig. 5

Table 9 The existing and projected pipelines in the Middle East

Origin	Transit Countries	Terminal	Length in Miles	Diameter in inches	Throughput 1968 b/d	Notes
Existing						
Northern Iraq	Syria-Lebanon	Tripoli	532	12	1,079,800	System includes 111 miles 16" from Homs to Tripoli, and 40 miles 26" and 24" from Homs to Banias.
	Syria-Lebanon	Tripoli	532	30/32		
	Syria	Banias	555	30/32		
Eastern Saudi Arabia	Jordan-Syria-Lebanon	Sidon	750	30/31	470,900	Length 1,070 miles including section from main fields to Qaisumah Capacity 70,000 b/d.
Southern Israel (Eilat - Gulf of Aqaba)	-	Haifa	256	16	110,000 est.	-
Southern Israel	-	Ashkelon	160	42	-	Capacity 380,000 b/d. Ultimate capacity 1,200,000 b/d.
Projected						
Egypt (Gulf of Suez)	-	Alexandria	210	42	-	Capacity 1,000,000 b/d.
Southern Iran	Turkey	Iskanderun	950	48	-	Under study

Source: Petroleum Press Service, June, 1969, p.216.

IPC Pipelines

The capacity of IPC's pipeline was increased from 26 million tons a year to about 40 million tons a year as a result of technical improvements and by completion of another parallel line from Kirkuk to Tripoli, the Syrian port on the Mediterranean in August 1961.[41] In 1968, the IPC pipelines moved about 73.5% of Iraq's total exports, and 16.2 million tons were shipped from Khor al-Amaya, the Iraqi port on the Gulf. In recent years special preference has been given to the southern fields because of the troubles which IPC faced in operating the northern lines via Syria. The latest of these troubles occurred on December 8th, 1966, when the Syrian Government shut down the IPC pipelines completely, pending a raise in transit dues from 56 cents to 81 cents per ton of crude oil, and loading fees at the Banias terminal from 15 cents to 28 cents. Over and above this the Government demanded that these increases should be applied with effect from January 1st, 1966. After about three months of deadlock, IPC agreed to the Syrian demands in the first week of March, 1967, and accordingly oil flowed again through IPC's pipelines across Syria to the Mediterranean. Total dues then worked out at $1.09 per ton (14.6 cents per barrel) compared with 71 cents per ton (9.5 cents per barrel) at the old rate, an increase of nearly 50%. On the signing of the agreement, the Syrian Government received an amount of $13.7 million from IPC representing the increase in payments for the previous year (January 1st - December 1966) on the basis of the new rates. Based on the pre-stoppage rate of 43 million tons of crude oil a year, Syrian revenues would have been about $42 million instead of under $28 million.[42] While the Syrians got a fairly substantial increase in their income, the Iraqis lost about $65.8 million during the shut-down period.[43]

Trans-Arabian Pipeline (Tapline)

Tapline is a wholly-owned subsidiary of ARAMCO. The pipeline has a length of 750 miles and a diameter of 30"/31", and the purpose behind constructing it was to eliminate the tanker voyage around the Arabian Peninsula and through the Canal, a round trip of over 6,000 miles when exporting oil to Western Europe. The conditions and climate in the mid-Arabian desert made working very difficult. To overcome the lack of water, 50 or more wells were drilled in the desert, and water was transported from Ras Tanura and Januf by lorries. The difficult surface of the land - sand-dunes, flat and arid plains, hard or disintegrated limestone, and lava strewn desert - was tackled with many specially designed vehicles and the building of roads. However, the line was completed in 1950 using 265,000 tons of steel, and at a cost of $224 million. It is operated by four major stations (Qaisumah, Rafha, Badamah, and Turaif) and four minor ones (Shu'-bah, Uwaigilah, Jalamid, in Saudi Arabia, and Qaryatain in Jordan).[44] (See Fig. 5.) The capacity of the line was increased from 16 million tons a year to 22 million tons a year by the end of 1958 and to about 25 million tons a year in 1966.[45]

Likewise, Tapline faced difficulties with regard to both transit dues and the operation of the line. The latest incident took place on May 3rd, 1970, in Syrian territory near the town of Derra.* It was claimed by the Syrian Government that a bulldozer accidentally damaged the pipeline while engaged in cable-laying work for the Syrian telephone department. (At the point the line is buried 6 ft. deep.) Oil spillage which caused some pollution to the surrounding. agricultural land was estimated at 20,000 barrels, but no fire broke out. After the damage, a Tapline repair team was going to Syria to investigate the damage, but they were prevented by the Syrians on the grounds that there was a fire hazard.[46] Although at the beginning the Syrians did not spell out their terms for the repair of the line, in June it was fairly certain that they wanted higher

* Since the Arab-Israeli War of June 1967, but before this incident, several things happened to the Tapline. In 1967, following the War, the line was shut for over three months. Later, in 1969, the line was closed once again for 112 days, when a group of Palestinian Commandos sabotaged the line in the Israeli occupied Gulan Heights. Also several minor accidents have occurred to the line in Lebanese territory.

transit payments.*[47] After 7 weeks of the shut-down and the refusal of the Syrians to give Tapline crews the necessary clearance for the repair of the line which was estimated to take about 24 hours, the Saudi Government decided to abandon the line altogether.[48] However, in November, 1970, there was a coup in Syria, and the government was changed. Negotiations for the re-opening of the Tapline were recommenced, and on 29th January, 1971, the Tapline was reopened.[49]

Although Saudi Arabia was greatly affected by the closure of the line, Lebanon, Jordan, and Syria suffered too. Before May 3rd, Tapline transited about 470,000 barrels/day, or roughly 14% of ARAMCO's total production in Saudi Arabia, which amounted to 3.4 million barrels/day during the first quarter of 1970. The Saudi income from oil exported from Sidon was about $1 per barrel (or 15 cents more than the equivalent grade of oil exported from Ras Tanura on the Gulf). The extent of Saudi losses through the Tapline closure was governed by the amount of oil shipped from Ras Tanura. If Saudi Arabia had been able to put through Ras Tanura the same quantity of oil that was passed through the Tapline, then her losses would have amounted to $70,000 per day. This would have been the difference in prices between Ras Tanura and Sidon. On the other hand, if Saudi Arabia had not been able to replace what used to go through the Tapline by Ras Tanura, then its losses would have amounted to $500,000 per day. The three transit countries, Lebanon, Jordan, and Syria itself would have lost about $10,000 a day each. The effect on the operating company was bad, partly due to the increase in the costs of transporting and lifting supplies of oil from other sources, and partly due to the

* Syria started negotiations with Tapline for an increase in oil transit dues in May, 1967. However, because of the June War, negotiations between the two parties were suspended and never resumed.

disruption of their offtake and delivery schedules.[50] Also the shutdown of the Tapline, as well as the disruption of oil supplies from North Africa and the Middle East greatly influenced freight rates to rise. There is also a shortage of oil supplies to Western Europe from the Mediterranean, with the possible result of a price increase.*

When one compares the bargaining position of the Tapline Company with that of IPC with its pipelines, one can see that the Tapline Company is the stronger with regard to dues payable to countries through which it passes, or the transit of oil, because Saudi oil can easily be re-routed to the Gulf ports if pipeline dues were increased over the limit which the Company can bear.

Although some improvements were made to the Tapline in order to increase its transit capacity, the capacity of the terminal at Ras Tanura after its improvements remained greater. At Ras Tanura the improvements included an increase in the total capacity of the storage tanks and shipping facilities by the building of a new sea-island terminal. In 1969, Saudi exports to the Western Hemisphere amounted to 67.8 million tons of crude oil, while the Tapline's share of that was only 34%.

It is to be noted that in the case of Saudi Arabia, the Tapline seems of little importance with regard to export. That is clear from the amount of oil exported via the Tapline compared with Ras Tanura. The case of Iraq is a different matter, it seems impossible for Iraq to manage without the implementation of the northern lines.

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* The host governments in the Middle East and North Africa have been asking for higher posted prices and increased taxation. Also, the Libyan Government has decided to cut back its production from certain oil fields for protection. It is reported that the government has ordered Occidental to cut back production from its Intisar field from 320,000 barrels/day (April 1970 level) to around 200,000 barrels/day. This, together with the stoppage of the Tapline, created a shortage of oil in the Mediterranean.

b. <u>Pipelines (newly constructed and in planning stage)</u>

The consequences of the Suez Crisis of 1956, which were the closure of the Canal and the sabotage of the IPC pipelines in Syria, led to the oil companies concerned looking for an alternative route. The alternatives were the building of large tankers as mentioned previously (see Tankers), and the construction of new pipelines with larger diameters through countries with more political stability. Two conferences were held in London with regard to the problem. The first (mid-March, 1957) involved 8 oil companies, and the expansion and improvement of pipelines in the Middle East was discussed. The second conference (May 13-16 1957) comprised 17 oil corporations and studied a project to link Iraqi oil fields with Turkish ports on the Mediterranean, thus avoiding Syria and Egypt, which were less politically stable.[51] In general, as a result of the Suez Crisis, several projects were taken into consideration. Amongst these were:

(a) Eilat - Ashkelon pipeline - Israel.

(b) Suez - Alexandria pipeline - Egypt.

(c) Ahwaz - Iskaderun pipeline - from Iran to Turkey.

<u>Eilat - Askhelon Pipeline</u>

Israel also has a 42 inch pipeline, which was brought into operation in February, 1970, and runs from Eilat on the Gulf of Aqaba, 160 miles to Ashkelon on the Mediterranean. (See Fig. 5.) With the installation of a new pumping unit in the Negev, in May, 1970, the capacity of the line was raised from 400,000 to 800,000 barrels a day, and it is expected to reach its maximum capacity (1.2 million barrels a day) early in 1971.* The cost of the line (before expansion) including terminal and storage facilities at Eilat

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* No reliable information is available as to the actual current throughput.

and Ashkelon was estimated at $113 million. Transit dues charged by the Israeli Government are reported to be $1.00 per ton, or roughly 13.5 cents per barrel.[52] The facilities at Ashkelon are composed of storage tanks with a capacity of 1.5 million tons, and two 30 inch loading lines connected to a floating tanker terminal.

At present, tankers of between 35,000 dwt. and 75,000 dwt. can be handled there. In future, the terminal will be handling tankers of 125,000 dwt.[53] Tankers initially served at Eilat ranged from 40,000 to 125,000 dwt. With the completion of a new 750 metre-long oil pier, Eilat became capable of accommodating two tankers of 300,000 dwt. simultaneously. This pier was built at a cost of $7.5 million.*[54] The facilities at the pier can handle 23,000 tons of crude oil per hour compared with 15,000 tons per hour at the sea-island terminal in Kuwait, and less than 15,000 tons at Bantry Bay.[55] The older pier, which is located to the north of the new one, can handle another 17,000 tons per hour, making a total of 40,000 tons per hour for the two.[56]

The Israeli pipeline faces a number of difficulties which may become worse with the passage of time. Amongst them are firstly security problems. The Israeli pipe will remain an obvious target for Arab guerrillas as long as the Arab-Israeli conflict continues. In fact, in recent months, Egyptian frogmen have launched two successful attacks on Israeli ships in the port of Eilat. Secondly, there is the fact that if an oil company dependent on Arab oil used the pipeline directly or indirectly, it would run the risk of a boycott by the Arab states.

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* The new pier was built by the Genoa-based Italian firm, Adriatica, and it was reported that the firm received a bonus of $500,000 for completing the pier ahead of schedule. (M.E.E.S. No.45, 4th September, 1970).

Despite all these obstacles, the Israeli pipeline has been enlarged to an extent which leads one to believe that they may have other sources of oil to utilise these facilities. It seems that the main source of the East of Suez oil passing through Israel is Iran, and the main user of the Israeli pipeline is the National Iranian Oil Company, which appears to value its trade more than Arab feelings on the matter.[57] There is also speculation about whether the Israeli facilities will be employed by foreign oil companies operating in Iran. It is, however, unlikely that any of the companies connected with the Consortium would become involved for three reasons, namely: (1) they are committed to the mammoth tankers which seem to be the safest and most economic way of transporting oil from the Gulf to Europe, even allowing for the length of the route via the Cape. (2) They would not wish to endanger their enormous oil-producing interests in the Arab countries. (3) In the majority of cases, they already have enough oil sources on the Mediterranean .

It is most probable that material considerations are foremost in the reasoning of the Iranians, as they have been at a considerable disadvantage regarding competition since the Canal was closed. Obviously they need a way to reduce the costs of transporting their oil to Europe and the Israeli pipeline probably offers this. However, if another, more secure method became available, the Iranians would probably use that in preference, for instance, their own pipeline to the Mediterranean which has already been planned or participation in the Egyptian SUMED line. In these circumstances one cannot regard the Iranians as permanent users of the Israeli facilities.

The main reason for the flourishing nature of this trade is Eastern Europe's desperate need for oil, due in part to the inadequacy of the Russian supply network. Russia appears to have given the Eastern bloc sanction to import oil from any other sources, and Rumania and Yugoslavia among others have made barter deals with Iran. The world tanker shortage, however, left Rumania especially short in its oil supplies as Iran got progressively further behind in deliveries. The Israeli pipeline was the only solution, albeit a risky one. Another reason is the Shah of Iran's desire to establish Iran as a major oil seller through NIOC instead of relying on the marketing facilities of the Western oil companies drilling in Iran.[58]

NIOC receives its oil from various oil companies operating in Iran. Firstly, over a period of 5 years, NIOC is to receive from Consortium an amount of 20 million tons of oil for use in barter trade with the Comecon states of Eastern Europe. In addition tothis, NIOC is getting 50% of the oil produced by the companies which signed agreements with her on the basis of a joint venture (50/50 partnership).* Total output by the companies averaged some 275,000 barrels per day in 1969. It was expected to reach 450,000 barrels a day in 1970, and probably more than 300,000 barrels in 1971. It is to be noted that from this amount, 150,000 barrels a day will go to NIOC's markets to the East of Suez (India, Pakistan, Afghanistan, South Africa, etc.)[59]

A shortage in the quantity of oil at the Mediterranean was created by the reduction in Libya's production and the shutdown of the Tapline. Tanker freight rates were also affected adversely by the situation, and rose rapidly. Under these circumstances, the Israeli pipeline could be doing well. In fact, it seems as if this is the case, since the Israelis have already expanded the capacity of the pipeline from 400,000 barrels a day to 800,000, and it is expected that it will soon reach 1.2 million. Also, $7.5 million has been spent on building a pier at Eilat, capable of receiving mammoth tankers, and the contractor, who finished the job ahead of schedule, was given a $500,000

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* These companies are SIRIP, IPAC, LAPCO, and IMINOCO.

bonus, which seems to imply that the facilities were urgently required. One could speculate that all this planning was not done on a short term basis, but with something in mind for the future. Another point in favour of this argument is the calculation based on the reported pipeline tariff of $1.00 per ton (13.5 cents per barrel), that the line needs a minimum amount of 25 million tons per year (500,000 barrels per day) of oil passing through it, to allow for only 6% returns on the investment.[60]

Suez - Alexandria Pipeline

The idea of stretching a pipeline from the Gulf of Suez to Alexandria on the Mediterranean could be related to various factors, among which are the emergence of huge tankers even before the closure of the Canal, which rendered the Canal less necessary for the oil industry, and also that this pipeline was believed to be a compensation to Egypt for what she had lost from the oil transit dues through the Suez Canal.

The projected line would have a diameter of 42 inches and a length of 206.2 miles. It is believed that the line will require 100,250 tons of steel. It would run from a point south of the port of Suez to a point 13.1 miles west of Alexandria, where it is suitable for the building of the terminal. On its route, the line would reach a maximum altitude of 15,240 feet above sea level between the River Nile and the starting point. It would cross the river south of Cairo at a point where the river width is 16,764 feet. The line would not face any difficulty on the route, except when crossing the swamp area, south-west of Alexandria, which extends to a distance of about 18.8 miles.[61] (See Fig. 5.) As a safety measure, it is understood that the line would start from a point where it will be as far as 40 miles from the Israeli positions on the eastern bank of the Canal. It would have two pumping stations, each with a capacity of 41,000 h.p., which would give the line an initial throughput of 50 million tons a year (about 1 million barrels a day). At each end of the line a storage capacity of 863,000 tons would be available. The marine facilities at Suez would be capable of handling tankers of over 300,000 dwt., while at Alexandria, tankers ranging between 50,000 dwt. and 250,000 dwt. would be accommodated. Loading capacity at Alexandria would be 15,000 tons per hour.[62]

The Egyptians seem to be very optimistic about their line. It is expected that when it is opened, it will transport 36% of the amount of oil moved through the Canal in 1966, the last full year of operation. They also believe that even should the canal re-open, the line would be profitable, moving petroleum between supertankers which cannot use the Canal, and cutting by half the time taken by tankers to travel round the Cape.

The projected pipeline is at present facing difficulty with regard to its finances. It is estimated that the line would cost about $130 million. Political unrest in the Middle East has also resulted in the interest rates rising from a hopefully anticipated 7-8% to roughly 11-12%. In spite of this, the Egyptians believe that the project could still pay for itself in 7 years.[63]

This pipeline, if it is built, is more likely to be used than that of the Israelis, because most of the oil produced is from Arab countries, whose sympathies lie mainly with Egypt.

Ahwaz-Iskanderun Pipeline

There are several possible reasons for the Iranian's obvious anxiety to build the Ahwaz-Iskanderun pipeline. These include the desire to reduce the degree of monopoly of the oil companies in producing and marketing the oil, and to have a part in it themselves and make some money from it. A less obvious reason may be that the Iranians wish to sell oil to the countries of Eastern Europe, as well as boosting their Western European sales. To secure these markets they must sell as cheaply as possible, the least expensive method of transporting oil being via the pipeline. A third reason could be that the Iranians wish to make a profit from the difference between the posted prices at the Gulf and the Mediterranean. Although at present there are some differences between these prices, they may become less in the near future with the employment of supertankers. A case in point is Libya. Despite the convenience of Libyan oil, the demand for it may reduce because of the increased taxation and political unrest there. Another example of the influence of political unrest on the oil industry is the Tapline, which passes from Saudi Arabia through Jordan, Syria, and the Lebanon, to the Mediterranean. The line was damaged in Syria, and after much argument between the Syrians and the Saudis, the latter finally decided to discontinue use of the line until a fortuitous change in political conditions permitted a re-opening of the line. Thus it may be seen how Western Europe is being driven to depend more upon supertankers, and less upon pipelines to the Mediterranean.

Another point in the argument against the pipeline is that the Mediterranean will become less important after the advent of the supertankers and the use of terminals such as Bantry Bay and Rotterdam. To use a pipeline and a small tanker costs more than to use a supertanker alone. (See Comparative costs of using pipelines and tankers.)

The reasons given by the Iranians themselves are that they have wanted a pipeline outlet to the Mediterranean since the 1950's, and after the Canal closure in 1967 the plan became even more important to them in order to restore Iran's ability to compete for Western European markets, and to possibly open up new markets in Eastern Europe and West of Suez. It is believed that NIOC itself can provide 30% (3-400,000 b/d), of the pipeline's capacity with its planned sales to Turkey and Eastern and Western Europe.

At first the Consortium participants did not wish to become involved with the pipeline, as they felt that it was not a good proposition, either financially or as regards security. It was, and in some cases still is, thought that the line could not compete economically with the supertankers on the Cape route, and that it would be subject to political pressures.[64]

On the 24th September, 1970, the Turkish and Iranian Governments, and members of Consortium, were represented at talks in London regarding the new pipeline, where it was attempted to ensure a sufficient throughput of oil to make the project economical. Since then, some of the companies have been reported as changing their opinions to be slightly less against the pipeline, although it is still doubted that the amount of oil required can be guaranteed.[65]

The projected line will be 1,700 km. long, with a diameter of 30", 42" and 48", and an initial capacity of 800,000 barrels per day, capable of being raised to 1.4 million barrels per day. This will be the most difficult line to construct, and there are several reasons for this. The first and main one is the mountains through which the pipeline will travel more or less all the way. The climate changes from hot weather at the Gulf to snow on the mountains, ending with the Mediterranean climate of Iskanderun. This may lead to the pipeline having to be heated in cold areas to keep the oil flowing. The isolation and bad climate of the sites makes obtaining labour very difficult, and also getting materials to the sites to work with is a problem. As a result of these conditions, the whole operation will be very expensive. The cost of the initial stage of the project was estimated at $480 million. It was expected that this would reach a final cost of $550 million. However, these estimates have been revised once again, and it is understood that the cost now stands between $700 million and $1,000 million.[66] On 16th May, 1970, the Iranian and Turkish Governments signed a preliminary agreement with two international construction firms, Bechtel Corporation of the U.S.A. and Entrepose of France, for the construction of the line and 10 years' operation management of it on completion. The two companies also undertook to arrange the necessary finance for the project, provided that adequate throughput of oil was guaranteed by the operating companies in Iran.[67] It has been reported that the authorities would ask 35 cents a barrel in transit fees, which is almost 3 times as much as that charged by the Israelis, and 2 cents a barrel as port dues at Iskanderun for the use of facilities.[68]

5. Comparative costs of using pipelines and tankers

During the past 10 years, the oil industry has concentrated mainly on finding a way to reduce the cost of moving oil to refineries which are placed near the markets. This reduction is of great importance to the companies, as transport is the most expensive item in the operating costs. As a result of the increase in tanker and pipeline sizes, the cost of transporting crude oil has been reduced. These changes were made possible by advances in technology prompted by competition within the industry.

Firstly, it can be seen from Figure 6* that reduction in the cost of transport can be achieved by increasing the capacity of both means of transport. Secondly, as far as pipelines are concerned, after the cost reaches a minimum, it remains constant irrespective of distance, whereas tanker costs

* It is regretted that the figures used are based on the situation before the closure of the Suez Canal. No later figures are at present available.

decrease as the distance increases. This is because a tanker spends a smaller percentage of the total voyage time in port, thanks to better facilities at the ports for loading and unloading.

The cost of using a pipeline today (excluding profit, transit fees and taxes), varies according to the size of the pipeline. A barrel of oil could travel 1,000 miles along a 30" pipeline for a cost of roughly 14 cents, and as the diameter increases, so the cost decreases, i.e. 12 cents for a 36" pipe, 11 cents for a 42" line. The cost of using the alternative, ocean tankers, shows similar trends. On a 6,000 mile journey in a tanker of 50,000 dwt., the cost of moving one barrel 1,000 miles could be 7-8 cents, this decreases to 5-6 cents in a tanker of 100,000 dwt., to 3½-4 cents in a 200,000 tonner, and to 2½-3 cents in a 300,000 tonner.

Special costs are also included on the normal Gulf to Eastern Mediterranean routes by both pipelines and tankers. Those comprise (a) pipeline transit fees and other special fees which amount to about 20 cents for one barrel to travel 1,000 miles, and (b) Suez Canal fees of roughly 12 cents per barrel on a tanker round trip. From this it can be reckoned that to carry crude oil 1,000 miles by pipeline from the Gulf to the Eastern Mediterranean would cost 34 cents per barrel in a 30" pipeline, 32 cents in a 36" pipeline, and 31 cents in a 42" line. Alternatively, by tankers over the 3,000 miles sea route from the Gulf to the Eastern Mediterranean, it would cost about 37½ cents per barrel in a 50,000 dwt. tanker, 31½ cents in a 100,000 dwt. tanker, and 25½ cents in a 200,000 tonner. When calculating the last two figures, it has been assumed that the Canal was sufficiently deepened, and the tolls unaltered. However, it should be remembered that there is an extra journey of 1,500 miles by water between the Eastern Mediterranean and South Central Europe, and from the Eastern Mediterranean to North Central Europe is 3,000 miles. This costs roughly an extra 15 cents per barrel to Southern Europe, and 25 cents per barrel to Northern Europe in a tanker of 50,000 dwt. In a 100,000 dwt. tanker, the cost would be 11 cents to the South and 20 cents to the North. The Table below shows the cost of transport from the Gulf to South and North Europe.

Table 10 Transport costs from the Gulf to Europe

Means of Transport	South (in cents)	North (in cents)
30" pipeline + 50,000 dwt. tanker	49	59
via Suez in a 50,000 dwt. tanker	48	60
42" pipeline + 100,000 dwt. tanker	42	50
via Suez in a 100,000 dwt. tanker	39	48

Source: Petroleum Press Service, February, 1968, p.59.

The route via the Cape is a third possibility for oil travelling from the Gulf to Europe. Again, costs of transport seem to decrease as the tanker tonnage increases, i.e. 71 cents per barrel for a 50,000 dwt. tanker, 60 cents for 100,000 dwt., 39 cents for 200,000 dwt., 32 cents for 300,000 dwt., and 28 cents for 500,000 dwt. These are the approximate costs per barrel, of transporting oil to either North or South Europe. However, as few ports in Europe have facilities to deal with tankers over 200,000 dwt., the larger ones are penalised by the extra cost of transhipment to the destination, which amounts to 4-6 cents per barrel. This brings these costs to roughly the same as those of the 200,000 dwt. tankers going direct.[69]

From those figures it can be concluded that it is not probable that any more pipelines will be constructed between the Gulf and the Eastern Mediterranean, and that most of the tankers to be built will be in the 200,000 dwt. class, or even larger.

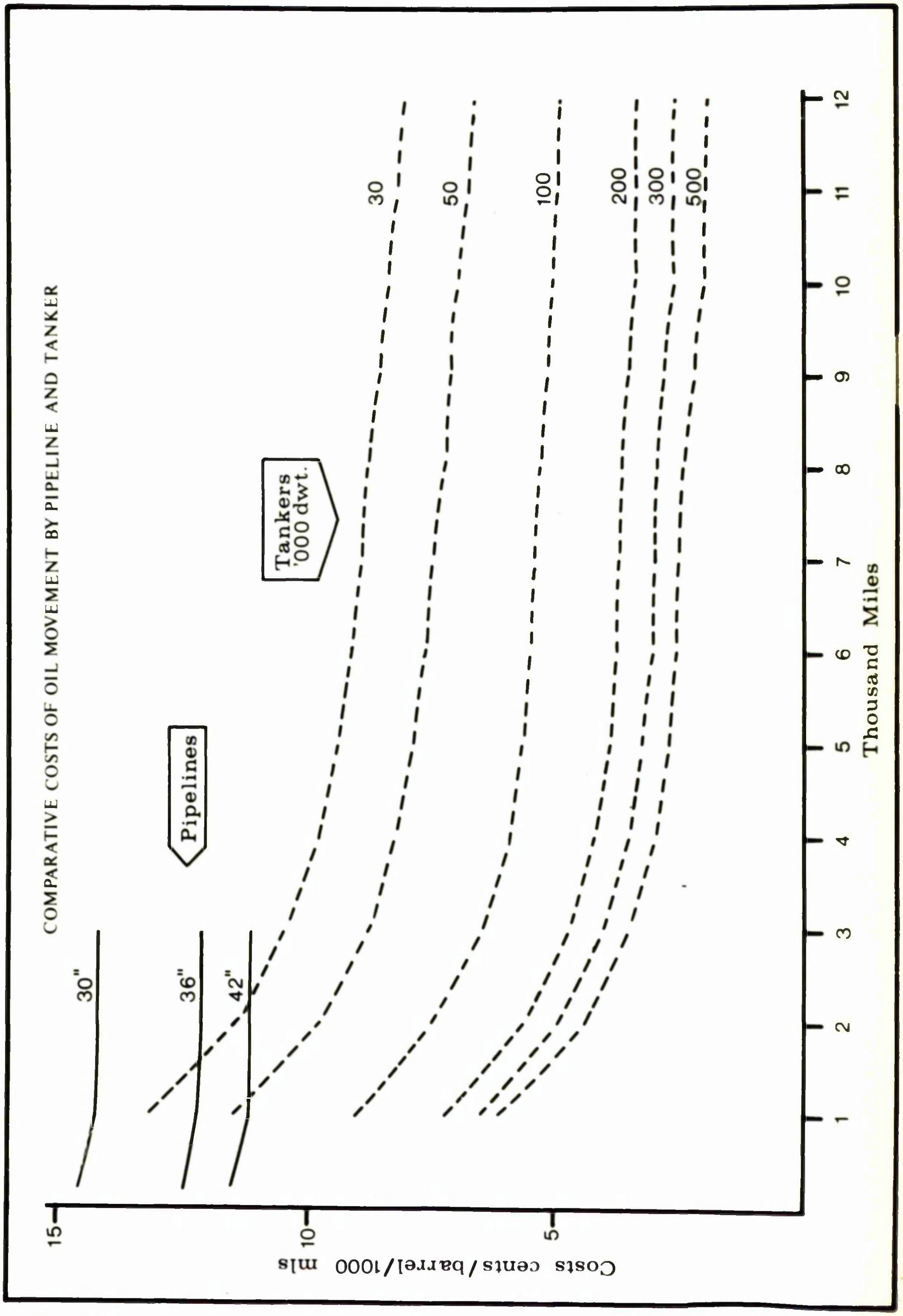
COMPARATIVE COSTS OF OIL MOVEMENT BY PIPELINE AND TANKER
Pipelines
30"
36"
42"
Tankers
'000 dwt.
30
50
100
200
300
500
Costs cents/barrel/1000 mls
15
10
5
Thousand Miles
1
2
3
4
5
6
7
8
9
10
11
12

Fig. 6

NOTES

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58. Ibid.

59. Middle East Economic Survey, Vol.XIII, No.18, 27th February, 1970.

60. Ibid.

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63. Richard Johns, "Egypt will go ahead with Suez pipeline", The Financial Times, 8th April, 1969.

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65. Middle East Economic Survey, Vol.XIII, No.46, 11th September, 1970.

66. Middle East Economic Survey, Vol.XIII, No.20, 13th March, 1970.

67. Middle East Economic Survey, Vol.XIII, No.30, 22nd March, 1970.

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69. Petroleum Press Service, "Pipelines versus Tankers", February, 1968, p.59.

CHAPTER VI

THE EXPORT OF OIL

The oil which has such a great impact on the economies of Iran, Saudi Arabia, and Kuwait, is nearly all exported, since home consumption accounts for only a tiny fraction of production. Iran's local consumption amounted to 8.97% of its total production in 1968, while Kuwait consumed 4.78%, and Saudi Arabia's figure was 4.59%. Export figures have risen spectacularly since 1945, and while most of the exported oil has been destined for the highly developed countries of Western Europe, the pattern of trade has changed due to the interplay of competition from rival exporting producers, especially North African countries, and increasing demand from countries in different parts of the world. In recent years an increasing proportion of refined products has been exported as well as crude oil. In any one year over 90% of production has been exported to industrialised and other countries to be used in transport, electricity generation, petrochemical industries and for other purposes.

The volume of oil exported depends on a variety of factors, including levels of supply and demand, the location of the consuming markets, as well as the internal and international political situations.

Future demand for oil is linked to many factors, among which are population increase, the ability of oil to take the place of, or compete with, other sources of energy, such as coal, natural gas, water-power, and atomic energy, and the degree of development achieved in any area or country. It is such development, measured by the intensity of industrialisation, including transport facilities, which are to a great extent dependent on oil.[1] The quantity and percentage of each source of energy consumed from 1929 to 1966 is given in Table 1.

Table 1 World consumption of energy in millions of tons of coal equivalent

Year	Original lignite quantity	Energy + Coal %age in proportion to total	Crude oil quantity	%age in proportion to total	Natural gas quantity	%age in proportion to total	Water-power + atomic energy quantity	%age in proportion to total	Total energy sources
1929	1,367	79.7	255	14.8	76	4.4	14	0.8	1,712
1937	1,361	74.5	328	17.9	115	6.3	22	1.2	1,826
1950	1,569	62.2	636	25.2	273	10.8	41	1.6	2,519
1955	1,816	56.4	948	29.5	397	12.3	59	1.8	3,230
1960	2,204	52.0	1,323	31.2	620	14.6	86	2.0	4,233
1963	2,173	46.2	1,628	34.5	800	17.0	100	2.1	4,697
1964	2,227	45.0	1,757	35.3	875	17.5	105	2.1	4,965
1965	2,257	43.4	1,918	36.7	931	17.8	116	2.2	5,273
1966	2,296	41.6	2,075	37.7	1,013	18.4	125	2.3	5,509
1975	2,653	31.9	3,829	46.0	1,634	19.6	202	2.5	8,318

Source: Nabel Aguib Sorial – Future of demand for Arab crude oil, a Paper presented to the 7th Arab Petroleum Congress, Kuwait, March 16th - 22nd, 1970.

It can be noted from the above table that in 1966, despite the increasing use of crude oil and natural gas, (which rose from 19.2% in 1929, to 56.1% in 1966), the ratio of solid energy to total energy dropped from 79.7% in 1929, to 41.6% in 1966. This can be attributed to the growing preference for the use of oil rather than coal, because it is so much easier to transport, occupies less space, and is clean and easy to manage. It also requires less manpower for its use. Thus it can be assumed that the increasing leaning towards the use of oil instead of coal, will assert itself in the future demand for oil.

The increase in the use of natural gas from 4.4% in 1929 to 10.4% in 1966 indicates that natural gas will be an important rival as a source of energy in the future.

Due to the rapid economic development of West European countries, and therefore the increase in the consumption of energy, the use of water power and atomic energy in the operation process has risen recently. Also, European countries are endeavouring to find new sources of energy since the stoppage of oil flow through the pipelines to the Mediterranean, and the nationalisation of the Suez Canal.[2]

Although coal has for many years been one of Western Europe's most vital sources of energy, the world is now rapidly becoming dependent on oil.[3] From Table 1 it is clear that the percentage of coal with regard to total energy has declined, (from 79.7% in 1929, to 52% in 1960, and to 41.6% in 1966), and it is expected to reach 31.9% by 1975. This decline is expected to continue for some time thereafter.

The decline in coal consumption can be attributed partly to technological factors, and partly to the difficulty in lowering prices to rates competitive with other sources of energy.[4]

Gas production has increased, but while many consumers changed over from coal to gas, industry turned to oil for raw materials for gas making. All the Gas Council's planned plants are based on oil and natural gas conversions, because the cost is about½ of that of conventional coal carbonisation. The Council also purchases oil refining gas, natural gas, and liquified petroleum gas.[5] Also there has been a change-over from the use of coal to oil in transport, especially on the railways of the United Kingdom, where coal consumption declined from 14.9 million tons in 1945, to only 7.7 million tons in 1961. During the same period, oil consumption increased from practically nothing, to 290,000 tons. The reasons for the switch to oil were the economies in the running rate,* and because the public accepted diesel and electric motor power very readily.[6]

Consumers naturally prefer convenience, and this is the reason for the growing dependence on petroleum. In the first ten years after the second World War, the ease with which oil and natural gas could be obtained and developed led to their being more and more widely used. This was not the case with coal. Although the same amount of capital was invested in both coal and petroleum, coal showed no returns, while oil resources were being steadily developed, and pipelines, tankers, and refineries were constructed to facilitate the supply to the consumer. The lack of coal to meet demand thus led to many markets being opened to oil and natural gas.[7]

Another of oil's competitors as a fuel in Europe is natural gas, which

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* This is not only the economies in fuel, but is from the higher utilization obtained from electric and diesel locomotives. The ratio 25:8:5 states the proportion of time spent off-line by steam, diesel and electric locomotives respectively.

is being increasingly explored for in the North Sea. More than 130 exploration wells were drilled in the North Sea by the end of 1968, and of these 16 resulted in field discoveries. In the U.K. there were 13, in the Netherlands 2, and in Norway 1. One year later there were 18 rigs operating in the area (U.K. 9, Netherlands 6, Norway 2, Denmark 1). It is indicated that there are adequate reserves in the North Sea to support gas as a main source of energy. Holland's Groningen field, which was discovered in 1959 has estimated reserves of 70 trillion cubic feet.[8] The first market which was penetrated by gas was the household one, and depending on the ultimate proven reserves, it may penetrate into commercial uses of light and middle oil distillates, and even into the bulk industrial market, where lower prices overall can be ensured through larger total initial markets, where sales can be built up fast.[9] Gas has advantages over oil in that it does not require storage, is clean, and is easy to control. It is reckoned that gas will have 15% of European and U.K. markets by 1980, although this is again dependent on the proven reserves, and realistic pricing. It is even possible that this figure could be as much as 20-25%. In 5 years time, Holland's fields could be supplying 11% of continental Europe's energy requirements. In 1960, this was only about 3%. 11% equals about 2.5 million barrels per day of oil. Under present estimates, gas should supply more energy to Europe by 1980, than oil did in 1960, when Europe used roughly 3.5 million barrels of oil per day.[10]

It is estimated that in 10 years time, the British gas industry could have 20% of the U.K. fuel market. In 1969, 10% of these needs were accounted for by manufactured gas and methane. It is believed that North Sea Gas will satisfy demand more economically than North African sources by 1980.[11]

The discovery of large reserves of natural gas would adversely affect the demand for coal as a source of energy. It could also, however, affect oil sales, as they are competitors for the markets, i.e. industry, and central heating, which provide the largest single market for oil products, and could be served equally well by gas.[12] While the demand for coal is decreasing, and no new plants are being built for gas-making from coal, demand for natural gas is on the increase.[13]

The third main rival to oil as a source of energy is nuclear power, which constitutes a very great threat to the supremacy of oil in world fuel markets. It is possible that the equivalent of about 3 million barrels per day of oil could be supplied by nuclear reactors to Europe by 1980. Demand for electrical energy doubled between 1959-1969, and it is expected to increase its share of total energy consumption in Europe from $\frac{1}{4}$ to $\frac{1}{3}$ by 1980.[14]

Today (1970), the European Economic Community imports just over 55% of its energy requirements. This figure may reach 62% in another 10 years. In the European Atomic Energy Community, there were only 16 nuclear power stations planned or under construction in October, 1968. By 1980, a minimum of 40,000 megawatts will be needed to supply 25% of the electrical production, while these 16 stations represent only 6,500 megawatts. Although 15% of the U.K.'s electricity is already from nuclear sources, less than 3% of Europe's electricity was supplied by nuclear energy in 1969, and it is reckoned that by 1980, nuclear energy will supply 8% of overall energy requirements in Europe, and 25% of electrical energy production.[15] From this it is evident that nuclear power as a source of energy cannot keep up with the swift expansion of Europe's energy consumption, and that at least until 1980, oil will be increasingly in demand.

Traditionally, the Middle East supplies over 50% of Europe's oil needs, and there is no reason to suppose that, barring untoward events, this state of affairs should not continue, and even expand.

In the world's largest oil market, the U.S.A., the cost of conventional energy is less than in Europe, yet almost ½ of the power plants ordered during 1966 and 1967, were equipped with nuclear reactors. By 1968, 87 units were under plan or in construction, representing 70,000 megawatts. After 1971, probably 80% of the U.S.A.'s generating facilities will be nuclear. Thus it is obvious that the delivered cost of oil products is an element in the race for the supplying of power plants.[16] However, possibility of the increased use of nuclear power as a source of energy in the future depends on several factors. It is clear from available evidence that nuclear energy will not be really able to compete as a source until 1980, but from then on large power stations will have been installed, and giving serious competition.

However, it is difficult to predict with accuracy the effect of the degree of nuclear development on the oil trade, as there are so many variables involved. These mostly concern costs, i.e. cost of Middle Eastern oil at the time, and the cost of producing nuclear power. Another point to be taken into consideration is whether atomic energy is capable of replacing oil in transportation.

1. <u>Geographical factors influencing international trade in oil</u>

Apart from the rival sources of energy to oil in world markets, there are other factors which influence the international oil trade to a certain degree, and among these are the following:

i Internal stability of the producing country.

The internal stability of a producing country is essential to the continuous flow of oil, as any instability has an adverse effect on the oil industry. To give an example, the nationalisation of the Iranian oil industry in 1951 resulted in the complete cessation of oil exports from Iran. The effect of this was not only the loss of revenue to the Iranian government, but also to create a shortage of oil in world markets. Another example is Nigeria, where the civil war of 1967 brought the Nigerian oil industry more or less to a standstill. Also, an internally stable country is more attractive to foreign investors.

ii. The political stability of the countries through whose territory the pipeline crosses, and where the loading terminals are situated

Examples of this are the pipelines which transport oil from the fields of north Iraq, and the Tapline from Saudi Arabia to the Mediterranean. The Iraqi pipelines were diverted from their terminal at Haifa in Palestine, to Baniyas and Tripoli in Syria, because of the Israeli capture of Haifa. These pipelines have been faced with many political obstacles in various years, the latest of which was in 1966, when pumping stopped through the pipelines for several weeks because Syria demanded an increase in transit dues. The situation is the same with regard to the political stability of the countries through which Tapline passes. For more details of political crises concerning both the Tapline and the Iraqi pipelines, see Transportation by Pipelines.

iii. The limitations of existing facilities within a country or a producing company

Usually, within a company, the output, or the amount of oil required for export is limited to the capacity of existing facilities within the producing oil company. To increase the amount of oil destined for export, it is necessary to increase the capacity of the production and loading facilities to cope. As an example, when Kuwait Oil Company wished to increase its export of crude oil, it increased its loading facilities by building a new sea island terminal, and then, to supply the required amount of oil to this terminal, the company was obliged to construct several new production units, and lay new pipelines to increase its production capacity. Another example is IPC's pipelines, which move oil from the northern fields of Iraq to the Mediterranean. If IPC intended to increase her exports beyond the limits of the capacity of the existing pipelines, it would have to either increase the number of pipelines, or construct lines with larger diameters, and bigger pumping units.

iv Political crises

International political problems of varying dimensions often affect oil exports from the Middle Eastern countries; for instance, the Suez Canal crisis of 1956. The supply of oil from the Middle East to Western Europe was then cut off by the closure of the Suez Canal, and sabotage to the Iraqi pipelines crossing Syrian territory. Also, the crisis of May 5th, 1967, between the Arabs and the Israelis, is still affecting oil exports from the Middle East, as the Suez Canal is again closed.

During the Arab-Israeli War of 1967, not only the Suez link was cut, but also the Trans-Arabian pipeline carrying oil from Saudi Arabia, and the pipeline system from the fields in the north of Iraq, (both to the eastern Mediterranean), were shut down. Production facilities were dislocated in a number of Arab countries in the Gulf area, and in North Africa. A new dimension was added to the crisis by the Arab States' ban on oil shipments to the United States, Britain, and West Germany.* Due to the crisis, an additional 12 million tons of tanker capacity was required to be in continuous service round the longer Cape route, as about 40% of Western Europe's usual oil supplies was affected.[17]

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* During the 1967 crisis, oil shipments from the Arab countries to the U.K. and the U.S. were banned because the Arabs believed that American and British aircraft helped the Israelis in the War. (The Times, July 8th, 1967). With regard to West Germany, the embargo was carried out by Iraq and Libya after the German Government had authorised the sale of gas-masks to Israel. (Christopher Tugendhat, Oil is the biggest business, London, 1968, p.285.)

At a time when production was decreasing in the Arab countries because of the June War, output was increasing tremendously in other areas, such as the United States and Venezuela in the Western Hemisphere, and Iran in the Gulf, to compensate for the loss of Arab oil. The United States stepped up its production by about 3.5 million tons between May and August of 1967. In addition to meeting its own import deficit of 27 million barrels of Middle Eastern oil, the United States shipped about 1.3 million tons of crude and partially refined oil to Britain over the same period. British imports of crude oil and refined products from the United States averaged just over 36,000 tons per month during the first half of 1967. In the months between May and August, 1967, production in Venezuela rose by 1.5 million tons. Iran, which is a non-Arab state, and therefore unaffected by the situation, despite its position on the Gulf, increased its production by nearly 1.8 million tons in the same period.[18]

To further elucidate the situation, the following table shows Britain's imports of crude oil and refined products during 1967.

Table 2 British imports of crude oil and refined products from various countries, monthly through 1967 (in thousand tons per month)

Month	United States	Venezuela	Iran	Saudi Arabia	Kuwait
January	46	1,458	833	3,158	2,619
February	23	1,984	1,007	2,310	3,146
March	58	986	576	3,041	3,499
April	20	1,223	703	2,336	3,463
May	41	1,330	756	1,950	3,328
June	30	1,461	249	1,673	2,961
July	620	2,265	2,260	464	679
August	2,073	1,618	6,687	-	-
September	1,658	1,068	7,006	409	520
October	473	1,029	6,680	2,164	992
November	25	775	3,852	1,344	1,949
December	49	1,230	3,447	1,770	1,241

Source: Board of Trade, Overseas Trade Accounts of United Kingdom, 41B Set 1, London, 1967, January-March, April-June, July-September, and October-December, p.51 in each.

Many consumer countries began to diversify their sources of oil supply after the first Suez closure, and the second closure in 1967 accelerated the process, thus greatly boosting exploration for petroleum in other parts of the world. The closures have also led to the construction of larger tankers capable of by-passing the Canal, as they exploit the economies of scale. (As the size of a tanker increases, the cost per ton-mile of moving a given quantity of oil decreases sharply). The changeover to larger tankers was inevitable, but was doubtless speeded up by the Suez crises and the subsequent uncertainty about that route.[19]

Western Europe is very vulnerable to any closure of the Suez Canal, and therefore maximum diversification of oil supplies took place there. Roughly 80% of Europe's crude oil requirements came from the Middle East in 1955, but only 51% was supplied in 1966, despite the fact that of Western Europe's rapidly expanding energy market, oil's share rose from 15% in the early 1950's, to roughly 56% in 1967.[20]

This shift from Middle East supplies was made possible by the emergence of vast oil resources in the North African Arab countries of Algeria and Libya, and to the West of Africa in Nigeria. These countries emerged as major oil producers and exporters during the period between the two Suez crises.

Table 3 illustrates the extent of the swing away from the Gulf to Africa. In 1970, Europe's imports of crude oil for the first time surpassed 10 million barrels per day. A total of 10,082,500 barrels a day was imported into Europe during the first half of 1970, and of this, 4,299,300 b/d came from African fields, and 5,005,100 b/d came from the Middle East, which therefore provided less than half of Europe's crude oil supplies for the first time in recent history. Meanwhile the African share of Europe's market is steadily increasing, and may soon pass the 50% mark. In 1967, the Middle East's share of Europe's market was 55.5%, but after the 6-day war of that year, it fell to 54.3% in 1968, and 53.3% in 1969. However, Africa's share has increased over the same period, from 31.3% in 1967, to 35.7% in 1968, 38.1% in 1969, and to 42.6% in the first half of 1970. The diversification of European imports is not only affecting the countries in the Gulf area, but also those in the Caribbean, and the U.S.S.R. The Caribbean share of the market dropped from 6.7% t in 1967, to a mere 3.8% during the first half of 1970, and the U.S.S.R. share fell from 4.5% in 1967, to 2.6% in 1970.

Table 3 Comparative increases in the amount of African crude oil imported by Western Europe

	Western Europe - crude imports (1,000 b/d)					
	M. East	Africa	Caribbean	U.S.S.R.	Other	Total
1967	4,174	2,354	504	336	156	7,524
% of total	55.5	31.3	6.7	4.5	2.0	100
1968	4,606	3,028	452	336	56	8,478
% of total	54.3	35.7	5.3	4.0	0.7	100
1969	5,116	3,658	426	302	104	9,606
% of total	53.3	38.1	4.4	3.1	3.1	100
1st ½ of 1970	5,005.1	4,299.3	379.1	258	141	10,082.5
% of total	49.6	42.6	3.8	2.6	1.4	100

Source: The Oil and Gas Journal, January 11th, 1971, p.21.

The main feature of Figure 1 is a steady increase in imports from the two North African countries, Algeria and Libya. Imports from West Africa show both upward and downward trends, especially in 1967, when decline was the main feature. This was because of the sharp drop in Nigerian output, caused by the Civil War, during which oil exports dropped from 500,000 barrels per day, to only 50,000 barrels. Contrary to those of North and West Africa, the picture

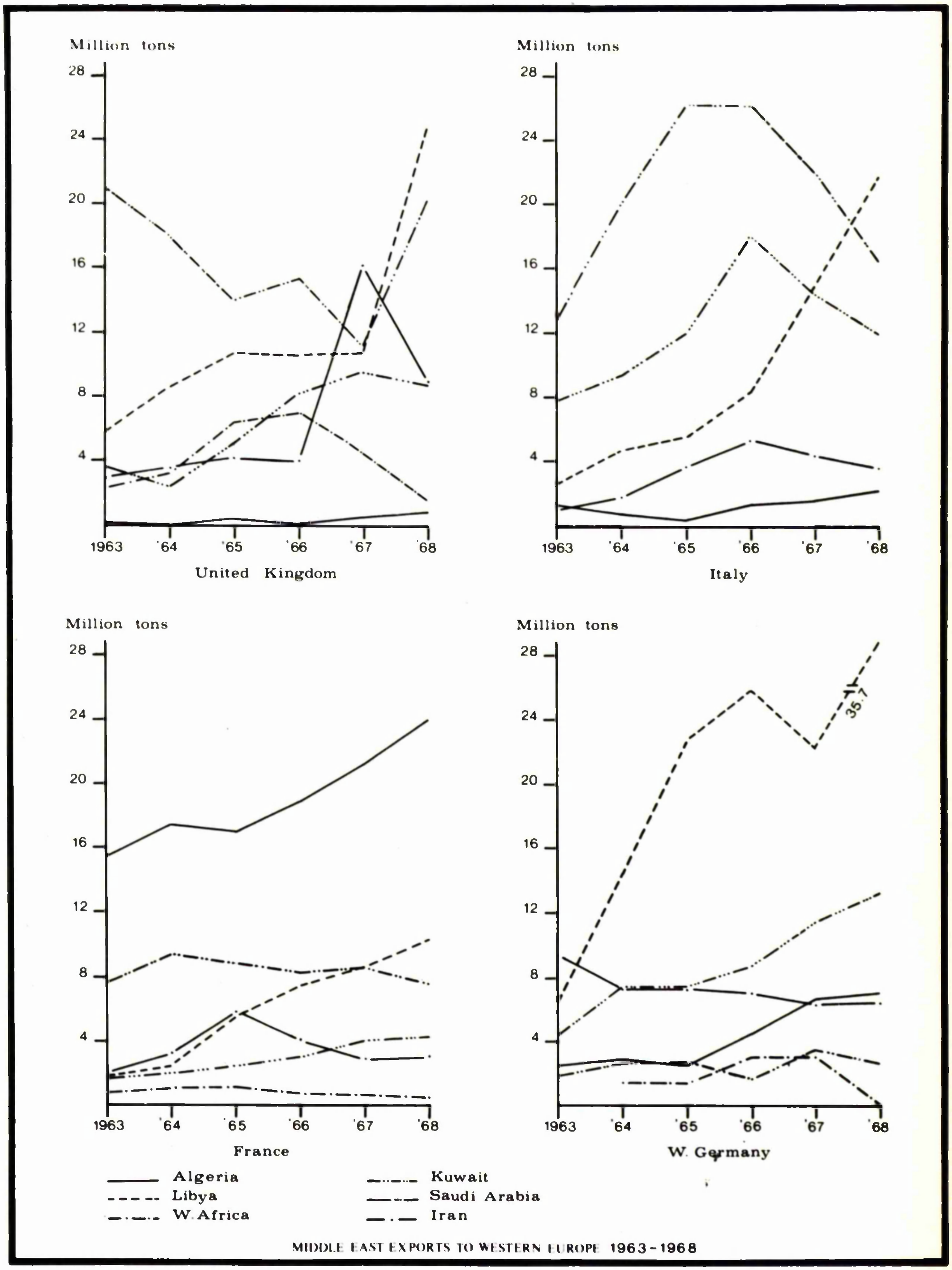
Million tons
28
24
20
16
12
8
4
1963
'64
'65
'66
'67
'68
United Kingdom
Italy
France
W. Germany
35.7
Algeria
Libya
W. Africa
Kuwait
Saudi Arabia
Iran
MIDDLE EAST EXPORTS TO WESTERN EUROPE 1963-1968

Fig. 1

for imports from the Gulf area shows a slight increase.

To derive a clearer picture of the extent of the swing from the Gulf towards other parts of the world, the imports of 4 major European consuming countries (the U.K., France, Italy, and West Germany), are shown in Fig.1.

West Germany showed a tremendous increase in its imports of Libyan oil. They rose from 6.5 million tons in 1963, to 35.7 million tons in 1968, an increase of 449%. This was accounted to 43% of total German oil imports in 1968. The second country in Western Europe to import Libyan oil in large quantities was Italy. Italy's imports from Libya increased by 707% in the same period. The United Kingdom also greatly increased its imports of Libyan crude oil, the amount being increased from 5.8 million tons in 1963, to 21.2 million tons in 1968, an increase of 265%. Unlike the other three countries, France increased its imports from Algeria from 15.4 million tons in 1963, to 24.1 million tons in 1968, an increase of 56%. A reason for these increased oil imports from the North African countries is that the Canal route is not used by tankers carrying oil from there to Europe, and the short Mediterranean crossing to Southern Europe is used to the advantage of the two North African countries.

At the end of 1967, the closure of the Suez Canal seemed no nearer to a solution, and B.P. planned to start using Libyan oil instead of Gulf oil. The company commenced a crash programme to increase Libyan production. Until June, 1967, 5 million tons a year were delivered to the Tobruk terminal by the B. P. operated pipeline. As B.P. worldwide handled 120 million tons a year, this was just a small drop in the ocean. However, by the end of 1967, 16 million tons a year was being sent through the pipeline, and the facilities at the terminal were expanded to accommodate two tankers at one time. Thus it would appear that B.P. may have made a policy decision to reduce the considerable dependence of the company on Middle Eastern oil by expanding Libyan oil fields, which are conveniently situated for Western Europe.[21]

In contrast to those of the North African countries, imports from the Gulf showed very slight increases, and in some cases, even decreases. For example, the United Kingdom's imports from Kuwait decreased from 21.1 million tons in 1963, to 11.3 million tons in 1967, a drop of 46% in 4 years. Iran's exports to West Germany dropped from 9.5 million tons in 1963, to 6.3 million tons in 1968, a decrease of 33%.

Apart from the diversification of supply to Western Europe, the search for fuel has been intensified in Europe itself. Over 20 million cubic feet of natural gas reserves have been discovered in the British sector of the North Sea,[22] and there has even been some oil, bringing closer the possibility of good strikes. Thus natural gas has begun to replace oil in Western Europe's fuel markets.

Japan and Australia drew 90% and 70% respectively of their supplies of crude oil from the Middle East, and although they do not suffer any direct effects from the Canal closure, the general uncertainty is shared by them both.

In conclusion, several main points can be raised from the Middle East crises, with special regard to the 1967 crisis. The effect of these upon the consuming countries of Western Europe varied considerably. No country suffered from a serious shortage of oil, and the crisis was evidently not of available supplies, but of tanker tonnage. However, at greatly increased freight rates, adequate tonnage became available in time to get supplies of oil to Western Europe without large drawings upon oil stocks.[23]

The Arab oil-producing countries of the Gulf put themselves in some danger with regard to the marketing of their produced oil. In fact, oil is of no value to a producing country unless it can be used, or sold to other countries.

As described above, the danger exists in the diversification of oil supply to Western Europe - the main consumer of Middle Eastern oil, and the intense search for oil and gas in other parts of the world.

Despite all the inconveniences caused to Middle Eastern oil in world markets by the Suez Crises, it will, with or without the use of the Suez Canal, continue to play an important role in the future, (at least for the next 10 years). In 1970, the region was not only famed for its oil production, which accounted for 30.5% of the world total, it also held more than 56% of the world's proven reserves of crude oil. The entire area is described as a huge reservoir of oil and some parts of it have not yet been thoroughly explored. The reason for the region's importance arises mainly from the low cost of production, in fact the lowest in the world. This low cost gives the Middle East a strong foot-hold in world markets, and enables it to compete favourably with its rivals.

Towards the end of the 1940's, physical and economic conditions favoured Kuwait's rapid expansion more than the other two countries under study. The most striking factors were lower royalty, large reserves, and lower unit costs. Thus, in spite of the fact that they had producing subsidiaries in neighbouring countries, companies like Shell, Jersey and Socony were interested in acquiring rights for long-term supplies of oil from Kuwait.[24]

The future of the development of Middle Eastern reserves looks as good as the past has been, with the financial and technical resources of the international oil companies, and their ready access to world markets available for this development.[25]

2. Areas of Demand and quantities exported

Although Iran, Saudi Arabia and Kuwait export oil to any place where markets can be found, their markets are largely concentrated in three major areas - Western Europe, Eastern and South-eastern Asia. At present in Western Europe, the main customers for the oil of the three countries are the United Kingdom, Italy, France, the Netherlands, Belgium, and West Germany. From Table 4 it can be seen that exports from Kuwait, Saudi Arabia and Iran to these countries have fluctuated greatly during the period 1962-1968. These fluctuations can be related either to the political crises, which led to the diversification of oil imports from the Gulf area, to North and West Africa, or to changes in demand for the various A.P.I. gravities, in particular that of Kuwait. As atmospheric pollution is of great concern in Europe, high sulphur content in oil renders it less acceptable than oil with a lower content.[26]

Table 4 Western Europe's imports of oil from Kuwait, Saudi Arabia, and Iran - 1962-1968 (1,000 tons)

From	To: Belgium	France	West Germany	Italy	Netherlands	U.K.	Others
Kuwait							
1962	1,142	7,960	1,655	11,534	5,625	23,139	1,243
1963	3,390	7,673	1,602	12,843	5,396	21,184	1,307
1964	1,954	9,489	2,708	20,341	5,591	18,094	2,435
1965	3,153	8,809	1,780	26,198	5,340	14,119	1,062
1966	3,339	8,202	1,635	26,191	5,884	15,766	3,236
1967	2,667	8,720	3,443	22,153	8,079	11,348	4,759
1968	3,022	7,666	2,642	16,553	10,436	20,329	5,232
Saudi Arabia							
1962	353	2,077	2,619	6,854	4,122	3,333	5,591
1963	94	1,731	4,380	7,841	3,877	3,610	5,792
1964	739	2,028	7,457	9,515	4,163	2,562	7,494
1965	882	2,460	7,974	12,139	2,955	5,017	3,766
1966	1,477	2,997	8,928	18,153	6,358	6,378	11,637
1967	946	3,994	11,566	14,458	4,860	9,668	13,505
1968	3,077	4,301	13,223	12,091	3,956	8,797	16,411
Iran							
1962	1,762	1,598	11,024	875	589	3,213	4,263
1963	3,846	1,999	9,554	1,041	999	3,002	4,440
1964	5,328	3,413	7,266	1,872	2,079	3,684	2,729
1965	5,412	5,805	6,019	3,747	4,361	4,208	2,051
1966	4,775	3,964	7,159	5,393	1,983	4,182	1,546
1967	3,420	2,864	6,332	4,434	2,116	16,337	2,467
1968	4,404	2,979	6,430	3,662	5,201	9,199	4,887

Source: Supply and disposal of oil - Statistics - Paris, 1962-68.

It can be seen from the quantities of oil exported (Table 4), by the three major operating companies in Iran, Saudi Arabia, and Kuwait, that Western Europe as an area is the largest importer of Saudi and Kuwaiti oil. Exports from Iran to Western Europe followed the same pattern until 1968, when Japanese imports of Iranian oil surpassed those of Europe by 11.67%. The gap was further increased in 1969, when it reached 46.85%. While Saudi exports to Japan showed an increase of 22.47% in 1968 over the 1967 figures, Kuwait's figures decreased by 15.67% between 1968 and 1967, and by 22.43% in 1969.

Again, the most obvious reason for the increase in exports of Iranian oil to Japan is the Suez Crisis of 1967. However, there is also the effect of Japan's changeover from coal to oil to be considered, along with the rapid growth of the Japanese economy, and the removal of the government's currency controls - controls which had the effect of limiting imports to Japan in order to conserve supplies of foreign exchange.[27]

Table 5 Destination of oil exported by Consortium, ARAMCO, and Kuwait Oil Company (million tons)

Destination by area	1966	% of total	1967	% of total	1968	% of total	1969	% of total
Iran								
Western Europe	33.3	42.2	40.8	41.0	33.1	30.4	31.7	25.2
Japan	24.6	31.1	37.2	37.4	45.8	42.1	58.9	46.9
Asia (excl. Japan)	7.3	9.2	9.2	9 2	15.4	14.2	16.8	13.4
North America	5.9	7.5	3.6	3.6	4.1	3.8	3.8	3.0
Africa	5.4	6.8	6.5	6.5	8.6	7.9	13.7	10.9
Australia	2.0	2.5	1.7	1.7	1.8	1.7	0.8	0.6
South America	0.5	0.6	0.5	0.5	-	-	-	-
Total	79.0		99.5		108.8		125.7	

cont'd

Table 5 (cont'd)

Destination by area	1966	% of total	1967	% of total	1968	% of total	1969	% of total
Saudi Arabia								
Western Europe	54.5	47.8	59.2	61.0	62.6	52.3		
Japan	14.6	12.8	17.8	18.3	21.8	18.2		
Asia (excl. Japan)	23.2	20.4	7.9	8.1	18.8	15.7		
North America	8.6	7.5	5.3	5.5	4.1	3.4		
Africa	3.3	2.9	-	-	3.8	3.2	N.A.	
Australia	4.5	3.9	1.0	1.0	3.7	3.1		
South America	5.3	4.6	5.9	6.1	4.8	4.0		
Total	114.0		97.1		119.6			
Kuwait								
Western Europe	63.6	63.0	61.4	60.0	67.8	63.1	72.8	64.4
Japan	16.7	16.5	18.5	18.1	15.6	14.5	12.1	10.7
Asia (excl. Japan)	11.4	11.3	14.8	14.5	14.8	13.8	18.4	16.3
North America	1.8	1.8	1.3	1.3	2.8	2.6	2.8	2.5
Africa	2.9	2.9	1.4	1.4	0.3	0.3	0.4	0.4
Australia	3.2	3.2	3.5	3.4	4.8	4.5	3.7	3.3
South America	1.9	1.9	1.5	1.5	1.3	1.2	2.8	2.5
Total	101.5		102.4		107.4		113.0	

Sources: Iranian Oil Operating Companies Annual Review, 1969
Ministry of Finance and Petroleum in Kuwait, 1970.
The Arab Organisation of Petroleum Exporting Countries, Kuwait, 1970.

These countries also export oil to North and South America, Africa, Asia, and Australia, as can be seen from the table.

The above discussion emphatically demonstrates that oil exports from the three countries concerned have been increasing at a remarkably fast rate since the first oil discoveries in those countries, except during times of hostility like the Second World War, and the political crises of 1956 and 1967. Based on the known reserves of oil in the countries and the existing trends of world consumption, it can be predicted that Iran, Saudi Arabia, and Kuwait will be able to continue to export their oil at the present rate for a long time to come.

The marketing situation, however, is not the only factor in determining the amount of oil a country exports. As was maintained in Chapter IV, physical conditions have great effect on the movement of oil in the individual producing countries. The effects of physical limitations are clearly reflected in the amounts of oil exported from the various countries of the Gulf, and this is particularly true in the case of Iraq. Fao was built as an oil terminal on the Gulf when Iraq started producing oil from its southern fields. However, it proved to be inadequate as an oil terminal, failing to meet the amount of oil required for export because of its position in the shallow waters of the Gulf, which prevents it from accommodating large tankers. Thus, in order to increase its exports from the southern fields, Iraq had to construct a new terminal in the deeper waters of the Gulf, 26 miles from Fao. This new terminal, Khor Al-Amaya, although located in deeper water than Fao, is still unable to accommodate the super-tankers which can be received in Iran, Saudi Arabia, and Kuwait. Table 6 below shows the movement of oil from the main terminals of the Gulf.

Table 6 Comparative amounts of oil exported from the main terminals of the Gulf (In million tons of crude oil)

Year	Fao and Khor Al-Amaya	Ras Tanura	Kharg	Mina al-Ahmadi
1965	17.8	55.8	68.2	96.3
1966	22.7	72.9	79.0	101.7
1967	19.9	85.8	99.5	102.3
1968	16.2	88.6	108.8	107.5
1969	16.4	101.8	125.7	113.3

Sources:- Data received from Kuwait Oil Company, April, 1970
ARAMCO, A Review of Operations, 1969
Iranian Oil Operating Companies, Annual Reviews, 1968 and 1969
Iraq, Basra, and Mosul Petroleum Companies, Reviews, 1968 and 1969

It is clear from the above table that the Iraqi exports from its terminals in the Gulf decreased by 7.8% between 1965 and 1969, while those of Saudi Arabia and Iran rose by 82.4% and 17.6% respectively. From early 1962 to 1967, both Fao and Khor Al-Amaya were operating as oil terminals in Iraq. The amount of oil exported from Fao ranged from 190,000 tons in 1965, to 1.7 million tons in 1967. Since then, oil exports from Fao have ceased, and the oil has been diverted through KhorAl-Amaya. The main reason for the cessation in the use of Fao is the shallowness of the water there, which prevents large tankers from approaching the terminal, and as the main market for Gulf oil is in Western Europe, it is uneconomical for the smaller tankers which can approach Fao to be used on such a long route. This indicates clearly that Iraq will be unable to expand its exports from its Gulf terminals at the same rate as those of Iran, Saudi Arabia, and Kuwait, mainly because of the physical limitation of the lack of water depth in the Iraqi part of the Gulf.

Thus it can be deduced that oil exploitation around the Gulf is affected by several factors, the main ones being political and geographical.

Political factors have led to oil companies abandoning parts of their concessions, and even, in some extreme cases, to halting operations completely while waiting for agreement to be reached. This is the case in both onshore and offshore concessions in the Gulf.

Oil exploitation is also greatly affected by the geography of an area. Onshore, the difference in costs of production between oil from a flat area and oil from a mountainous area is considerable. Pipelines, pumping stations, manpower, and various other considerations are less necessary in the former than the latter. Also, the distance from producing fields to terminals affects the cost of production, i.e. the further the oil has to travel, the more expensive it becomes to produce. Offshore, the effects of geography can be seen in shipping points as well as production. Some countries have advantages over others in the depth of water at their terminals, which enables large ships to use the facilities easily. In other countries where there is insufficient water depth, long submarine pipelines have to be laid to offshore terminals. This again increases the cost of production, while the capacity of the terminal and its facility for expansion determines the amount of oil to be produced.

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12. Bryan Cooper and T.F. Gaskell, op. cit., p.130.
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14. Walter E. MacDonald, op. cit., p.3.
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24. Zuhayr Mikdashi, A Financial Analysis of Middle Eastern Oil Concessions (1901-1965), New York, 1966, p.58.

25. Petroleum Gazette, op. cit., p.58.

26. Petroleum Press Service, "Kuwait's New Facilities", April, 1969, p.131.

27. Peter R. Odell, op. cit., p.93.

CONCLUSION

In the first half of the 20th century, the possibility of exploiting a hitherto unknown mineral resource as a response to new demands from industrial technology, superimposed a completely different economic system on the old subsistence and small trading activities of society in Iran, Saudi Arabia, and Kuwait.

The basic climatic problem of drought had evolved a landscape devoid of vegetation and unresponsive to most forms of primary agricultural activity in both Kuwait and Saudi Arabia. The population was consequently dependent upon sea resources and trade for its precarious existence. These two countries were among the poorest in the world with regard to financial wealth and known natural resources, but have become two of the world's most prosperous nations since the discovery of oil, although their incomes are almost entirely dependent on revenue from the oil industry.

In the "pre-oil" period Iran was in a slightly better position, as the land will support agriculture. Revenue from oil since its discovery and development, consequently constitutes a smaller percentage of the Iranian national income than it does in Kuwait and Saudi Arabia.

This thesis has attempted to analyse the development of this resource which made such wealth possible in these previously impoverished areas.

The first chapter has dealt with the location of the oil producing and consuming areas of the world in relation to the geographical position of the Gulf, and also with the varying effects of boundary disputes on those concerned with producing the oil. It was found that the oil producing areas of the world are widely separated. Some are favoured in their location as they are near to the consuming centres of high population density and industrial development, but the Gulf's location is not ideal because of the great distance its oil has to travel to reach the consumers. There are two main consuming centres for Gulf oil. They are Western Europe and the Far East - mainly Japan. Thus the oil of the Gulf, although cheap to produce, is adversely affected by the distance it has to travel, which raises the price to the consumer.

Oil production in the Gulf is greatly affected by boundary disputes, as oil companies are reluctant to exploit areas of dispute, even when these are strongly suspected to be oil-bearing. One of the most notable examples has been settlement of the onshore boundary between the Kuwait/Saudi Neutral Zone. and Kuwait proper. This led to problems for the oil companies operating in the area of the boundary. Kuwait Oil Company had surveyed an area thought to be in Kuwait, which was included in the Neutral Zone when the boundary was fixed, giving a considerable advantage to both Aminoil and Getty, who took over operations in the area. As regards offshore boundaries, the position is similar. The Kuwait/Shell Petroleum Company has ceased exploration activities in the offshore of Kuwait, pending a boundary settlement.

Although the main part of this thesis has examined different aspects of the exploitation of oil resources, these often contain elements which are not obviously directly geographical, for example the early history of oil exploitation and the granting of concessions, which, however, combine in their effect as basic features influencing the eventual patterns of oil exploitation and its influence on patterns of human activity in the areas concerned.

The structure of concessions has changed over the years. The earliest covered very large areas, sometimes entire countries. They were long-term with no provision made for relinquishment. Payments to host governments were in general low although some countries got better deals than others. In the early 1950's the basis of payments to the host governments changed considerably. Instead of receiving a royalty per ton of oil exported, the governments were receiving 50% of the net profits. Towards the end of the 1950's, two new types of concession were introduced into the area. These were joint-venture agreements, and the contracting of foreign companies by national companies.

When examining the oil reserves of the area in Chapter III, it was noted that the three countries under examination combine to possess the largest oil reserves in the world. Because of this, and favourable physical conditions and low labour costs, these countries have the lowest cost of production in the world, and as far as actual oil production is concerned, they are among the world's leading producers.

The pattern of intermediate oil movements in the countries concerned showed that some countries have advantages over others in their topography, as far as oil movement is concerned. For example, Iran's mountainous countryside is an obstacle to the easy movement of oil, while Kuwait's relatively flat surface is a definite advantage. However, Iran makes up for topographical disadvantages in landward movement of oil by its many advantages in sea transport. Its terminal is located in the deep waters of the Gulf, and it has also the best opportunities for future expansion. If the terminals of the northern Gulf were rated by their utility, it would be clear that Iranian ports take first place, followed by Kuwaiti, Saudi Arabian, and Iraqi terminals, in that order.

Chapter V dealt with the means of transporting oil from the Gulf to various parts of the world, mainly Western Europe, analysing the cost of oil transport by both tankers and pipelines. It can be seen that the increasing size of tankers is due in part to the economics of construction and operation. They are cheaper in cost per ton both to build and to run than small ones. The advent of the super-tanker led to the necessity for larger facilities, and although some receiving ports could be expanded, others had to be newly constructed. The closure of the Suez Canal also had an effect on the size of tankers, as it forced them to take a longer route, rendering smaller tankers impractical and uneconomic. The Suez crises of 1956 and 1967 also helped to continue the trend towards larger tankers, as oil companies were concerned to find an alternative to the Canal. Pipelines are also adversely affected by political crises, particularly when they cross more than one country, as disputes can lead to the disconnection of the pipeline. It was noted that comparative costs of transport by pipeline and tanker at present favour tankers. However some countries, such as Israel, disregarded the various disadvantages of pipelines, and have constructed large ones, mainly to take advantage of the present situation in the Middle East, in which the Suez Canal is closed, and there is an oil shortage in the eastern Mediterranean.

It is clear from the figures given in Chapter VI that the two main consuming areas forGulf oil are Western Europe and Japan. However, in recent years, the percentage of oil from the Gulf area used by Western Europe is decreasing, while the percentage obtained from other sources, such as North and West Africa, is increasing. This is because Western Europe is trying to reduce its dependence on Gulf oil because of the political situation in the Middle East, and the consequent unreliability of supply. There is also much exploration activity taking place, particularly in the North Sea. Also the range of power sources is widening to include nuclear power and natural gas in greater proportions than previously.

The amalgam of these features - physical, economic, and political - has produced a zone of immense material wealth and relative stability within a larger area of lesser political and economic stability. The way ahead for the zone, however, is largely dependent upon the interaction of the various external factors. The resource is established and changes within will almost certainly come from changes in patterns of demand or transport. From the evidence in this thesis it would appear that these later changes, although they might be great in themselves, will have relatively small influence on the geographical patterns of oil exploitation and internal transport, except in modifications in scale.

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